



4th National Conference on Ecosystem Restoration (NCER)

August 1-5, 2011

Baltimore Marriott Waterfront
Baltimore, Maryland





STATE OF MARYLAND
OFFICE OF THE GOVERNOR



MARTIN O'MALLEY
GOVERNOR

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TTY USERS CALL VIA MD RELAY

A MESSAGE FROM GOVERNOR MARTIN O'MALLEY

Dear Friends,

It is my pleasure to welcome you to Baltimore—the greatest city in America—for the 4th National Conference on Ecosystem Restoration.

Whenever possible we must work together to conserve, manage, and restore our lands and waters. Maryland has a strong and long-standing tradition of conservation, including the protection of our Bay, forests, farms, and historically significant lands. We continue to strengthen our conservation initiatives and nationally we must strive to do the same by building a spirit of cooperation.

America's treasured landscapes stand as our greatest legacy for future generations and it is our responsibility to sustain and restore the innate value of our natural resources. Over the last several years, the National Conference on Ecosystem Restoration has played an integral role in this pursuit, encouraging public discussion and building collaborative goals. It is not by chance but by choice that we will continue to set high standards in our efforts to conserve and restore our ecosystems.

On behalf of all Marylanders, I thank you for your attendance this week and for your dedication to the sustainability of our environment. Please accept my best wishes for a successful conference.

Sincerely,

Martin O'Malley
Governor

Fourth National Conference on Ecosystem Restoration (NCER)

Welcome to Baltimore, just up the harbor from Fort McHenry, where 199 years ago our forefathers fought to preserve our independence in a battle memorialized in the words of our National Anthem. Welcome also to the Chesapeake Bay region, the focus of one of the world's most ambitious and sustained programs to restore a large ecosystem, not to what it was in 1812, but to a far healthier and more productive condition than it since came to be.



4th National Conference on Ecosystem Restoration

The Spirit of Cooperation

Ecosystem restoration is challenging under any circumstances, but now in 2011 this is particularly so. On top of discouragingly slow progress in the nation's ecosystem restoration programs, we now face new constraints as the Nation must confront deficit reduction and the ecosystem restorers must adapt goals and strategies that take into account the clearly changing climate.

Initiated by the University of Florida, U.S. Geological Survey, U.S. Army Corps of Engineers and USDA's Natural Resources Conservation Service, the National Conference on Ecosystem Restoration (NCER) has become a critical force in addressing the nation's ecosystem restoration needs, bringing together restoration leaders and experts to share learning and seek common solutions. We are confident that this NCER will build on the success of the three earlier conferences, help us confront the challenges of 2011, and mature our community of practice.

NCER 2011 presents a full and outstanding program of technical presentations representing all areas of the country and providing a deeper exploration of the Chesapeake Bay Program. Undaunted by the exceptional suspense of 2011 caused by the late federal budget, threats of government shutdown, and uncertain travel authorization, Cheryl Ulrich and the members of the Program Committee have done an exceptional job in filling oral and poster sessions.

The program also includes a stellar line up of political leaders, agency officials and visionaries who are speaking in four plenary sessions. In addition, we will have two stimulating coffee house discussions—one on addressing the remaining challenges in achieving CB restoration goals and the other on providing perspectives from seasoned journalists on effective public communication regarding ecosystem restoration.

Field trips offer the opportunity to visit some of the many restoration sites in the area. Or explore Baltimore's Inner Harbor on your own, the spectacular pair of stadiums, the National Aquarium, the Maryland Science Center, Little Italy, Fell's Point, the many shops and restaurants, and efforts to make this urban harbor fully fishable and swimmable.

We thank our conference sponsors including those at the GOLD level - CDM, CWPPRA, Weston Solutions, and the University of Maryland Center for Environmental Science, and at the SILVER level – AECOM, Arcadis, Atkins, Brown and Caldwell, HDR, Louis Berger, Moffatt and Nichol, and Stanley Consultants. It would just not be possible to have a conference of this caliber without this support.

We also thank Beth Miller-Tipton and her skilled staff at the University of Florida's Office of Conferences and Institute for their work in organizing this NCER as they have all of the previous conferences. The exceptional quality of their work is a key reason with NCER has become a "must attend" event.

We trust you will take advantage of every opportunity NCER provides throughout the week to view posters, visit with exhibitors, attend program sessions and make new connections at our networking functions. We're glad you could join us.

On behalf of the entire planning committee, we as Conference Co-Chairs, welcome you to NCER 2011.

Don Boesch, President
University of Maryland
Center for Environmental Science (UMCES)

Suzette Kimball, Deputy Director
US Geological Survey

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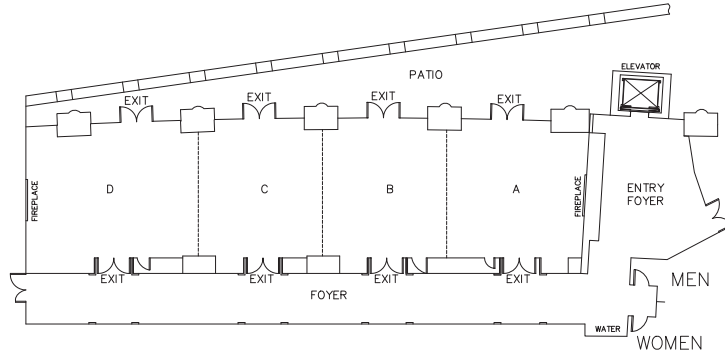
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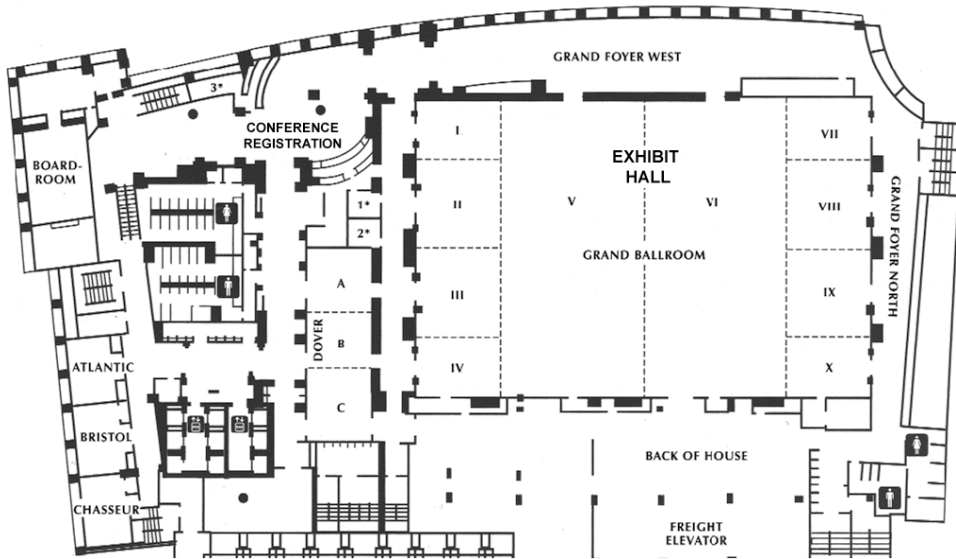
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Hotel Floor Plan

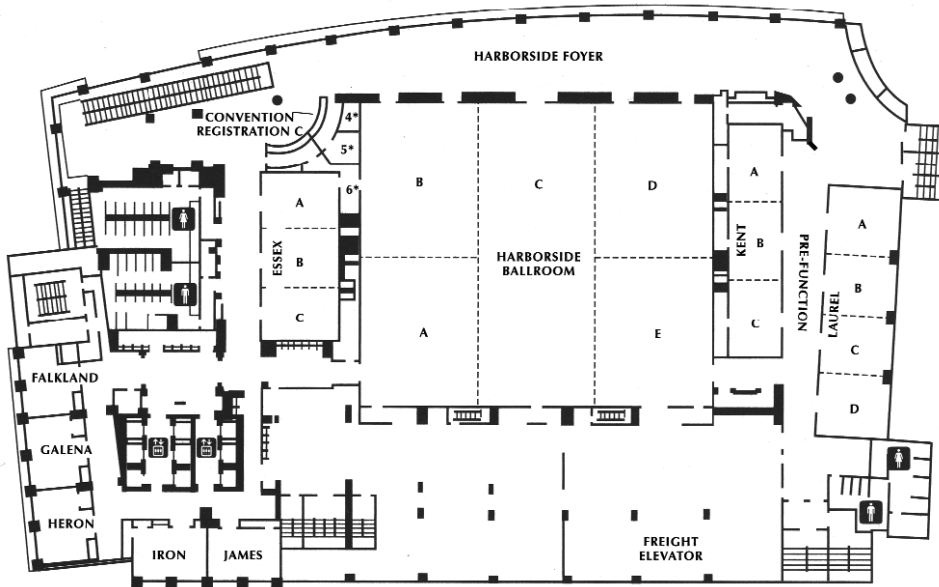
Waterview Ballroom – Lobby Level behind Restaurant



Third Floor WATERVIEW



Fourth Floor



Welcome Reception

Monday August 1st

7:00 p.m.-9:00 p.m.

Baltimore National Aquarium

501 East Pratt Street Baltimore, MD 21202

(Name badges are required for admission.)

Baltimore's National Aquarium strives to inspire visitors and partners to celebrate and nurture the world's aquatic habitats from tropical rain forests to coral reefs and from Baltimore's Chesapeake Bay to the world's oceans.

This year, participants of the 4th National Conference on Ecosystem Restoration will have a **free pass** to spend a beautiful evening at the Baltimore National Aquarium, exploring the aquatic surroundings and experiencing the passion the National Aquarium has for inspiring people to enjoy, respect, and protect the aquatic world.

In addition to their enthusiasm about aquatic life, the National Aquarium puts their "words into action" by confronting the pressing issues facing global aquatic habitats. They do this by serving the communities surrounding the state of Maryland, and have been for three decades. They host millions of Maryland students and teachers free of charge, and offer summer jobs, college internships, and scholarship programs. In addition, hundreds of local residents serve as the volunteers that guide and educate more than 1.8 million visitors to the Aquarium annually, and participate in hands-on efforts to restore and protect the Chesapeake Bay. By serving the community, the National Aquarium wishes to inspire future generations to strive for a world in which aquatic habitats are preserved and restored.

This week, participants will be able to see the 65,400 square feet exhibit entitled Animal Planet Australia: Wild Extreme. This breathtaking exhibit has a 35-foot waterfall and hand-crafted rockwork. The process of building the exhibit began over three years ago when the Aquarium staff visited the northern region of Australia in November 2001. They were especially struck by the beauty and rock formations of the country's gorges, as well as the unique wildlife. Australia is the world's largest island. Separated by ocean from the rest of the world, it has a higher percentage of endemic animals than any other continent on earth, and many of its species are not naturally found outside the country. Today, the exhibit hosts animals that are as diverse as they are plentiful. These animals are living creatures that are as close to prehistoric as can be found on earth, and were developed over millions of years in solitude. The highly adaptive animals in wild Australia have survived over millions of years in a land of drought, fire, and flood. Most of us will never get near any of these creatures without going to wild extremes.

Exhibitor Listing



AECOM Technologies Inc. [BOOTH #30]

WEB SITE: www.aecom.com

REPRESENTATIVE: Christopher Benosky, (christopher.benosky@aecom.com)

AECOM is a leading global provider of design, engineering, program management, construction management, and operations and maintenance support as well as technical assistance. Since it was launched as an independent company in 1990, AECOM has become one of the largest providers of professional technical and management support services in the world.



Arcadis, Inc. [BOOTH #4]

WEB SITE: www.arcadis-us.com

REPRESENTATIVE: Robert Daoust (Robert.Daoust@arcadis-us.com)

ARCADIS is an international company that provides consultancy, design, engineering and management services in the fields of Infrastructure, Water, Environment and Buildings. With more than 16,000 people worldwide the company has an extensive international network that is supported by strong local market positions. They rank among the top 10 management and engineering consultancies in the world. In Europe, Brazil, and Chile they have a top 5 position. In the global environmental market they are positioned in the top 3.



Brown and Caldwell [BOOTH #6]

WEB SITE: www.browncaldwell.com

REPRESENTATIVE: Lucila Silva (lcobb@brwncald.com)

Brown and Caldwell has built a reputation for collaborating with clients, adding value through innovation and building relationships that last. Dave Caldwell founded the company in 1947. He was a true visionary who pioneered and advocated wastewater reuse. Dave's belief that the needs of society, our clients and the environment can co-exist remains an integral part of our culture and is readily seen in the innovations and advancements of the BC engineers and scientists who have since followed.



CDM [BOOTH #11]

WEB SITE: www.cdm.com

REPRESENTATIVE: Timothy Feather (feathertd@cdm.com)

CDM is a consulting, engineering, construction, and operations firm that services public and private sector clients worldwide. We provide turn-key water resources services including ecosystem restoration at all scales.



Coastal Wetlands Planning, Protection, and Restoration Act [BOOTH #4]

WEB SITE: www.lacoast.gov

REPRESENTATIVE: Susan Testroet-Bergeron (BergeronS@usgs.gov)

The Coastal Wetlands Planning, Protection and Restoration Act is federal legislation enacted in 1990 that is designed to identify, prepare, and fund construction of coastal wetlands restoration projects. CWPPRA project managers, scientists, and engineers use a variety of techniques to protect, enhance, or restore wetlands. Since its inception, 151 coastal restoration or protection projects have been authorized, benefiting over 110,000 acres in Louisiana.





EA Engineering, Science, and Technology, Inc. [BOOTH #21]

WEB SITE: www.eaest.com

REPRESENTATIVE: Richard Pfingsten (rpfungsten@eaest.com)

For more than 30 years, EA has integrated science, engineering, and technology to provide valuable solutions to our clients' water resource, environmental and regulatory issues. EA provides technical expertise that begins with project conceptualization through final construction and continues with long-term operations and maintenance for ecosystem restoration (wetlands, stream, salt marsh, fresh water; fish passage); watershed and storm water management; TMDLs; sediment characterization and dredge material management.



HDR, Inc. [BOOTH #34]

WEB SITE: www.hdrinc.com

REPRESENTATIVE: Dana Stob (dana.stob@hdrinc.com)

HDR is an architectural, engineering and consulting firm that excels at managing complex projects and solving challenges for clients. We offer our clients the best possible economic, social and environmental value by delivering integrated sustainable solutions.



moffatt & nichol

Moffatt & Nichol [BOOTH #27]

WEB SITE: www.moffattnichol.com

REPRESENTATIVE: Peter Kotulak (pkotulak@moffattnichol.com)

Moffatt & Nichol is an internationally recognized engineering, planning and scientific firm that serves public and private clients worldwide from offices in the United States, Canada, the United Kingdom and Latin America. The firm specializes in coastal and water resources engineering and ecosystem restoration, as well as those involving civil works, ports and harbors, and transportation.



PARSONS [Booth #2]

WEB SITE: www.parsons.com

REPRESENTATIVE: José A. Buitrago Jr. (Tony.Buitrago@parsons.com)

Parsons is the company of choice for project execution. We offer a comprehensive selection of services that cover every aspect of a customer's program or project, including management, procurement, consulting, security, and alternative project delivery. Our long history reflects our innovative solutions that take a project from inception and startup, through execution, to testing and closeout—and often the project continues to serve as a model for the future! When a customer needs a “one-stop” shop for a project, we are selected because we focus on what's most important—the end result.



Stanley Consultants [BOOTH #3]

WEB SITE: www.stanleyconsultants.com

REPRESENTATIVE: Mark Henthorn
(HenthornMark@StanleyGroup.com)

Stanley Consultants is a global engineering company headquartered on the Mississippi in Muscatine, IA. With 1,200+ members, our proud eco-restoration experience reflects projects in the Everglades, Biscayne Bay, Lake Okeechobee and several major rivers.





TETRA TECH

TetraTech [BOOTH #12]

WEB SITE: www.tetrattech.com

REPRESENTATIVE: Eric Dohner (eric.dohner@tetrattech.com)

Tetra Tech was founded in 1966 as an environmental science and engineering company. We have 12,000 employees and annual revenues of \$2.3 billion for 2010. Our professionals represent over 45 scientific and engineering disciplines. One quarter of Tetra Tech's engineers, scientists, and managers hold doctoral degrees. A comparable number hold master's degrees. We are respected for our excellent business practices and outstanding reputation in science and engineering, consistently ranked among our peers as a national leader. We have successfully completed more than 5,000 coastal, environmental resource, and restoration projects, including significant work in the four major ecosystem restoration programs along the coasts of the US – the Chesapeake Bay, the California Delta, the Florida Everglades, and Louisiana – and the Great Lakes. Tetra Tech is focused and dedicated, through our Corporate Initiative Program, to provide the best resources from our highly skilled personnel to support ecosystem restoration programs throughout the US, particularly in the Gulf Coast.



The Louis Berger Group, Inc. [BOOTH #25]

WEB SITE: www.louisberger.com

REPRESENTATIVE: Ed Theriot (etheriot@louisberger.com)

The Louis Berger Group is an internationally recognized consulting firm that provides engineering, architecture, program and construction management, environmental planning and science, and economic development services. For nearly 60 years, they have been a devoted and trusted partner to U.S. federal, state and local government agencies.



University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE

University of Maryland [BOOTH #33]

WEB SITE: www.umces.edu

REPRESENTATIVE: Dave Nemazie (nemazie@umces.edu)

The University of Maryland Center for Environmental Science (UMCES) is the most prominent single institution involved in scientific discoveries about the Chesapeake Bay and its watershed. Although focusing more than 2/3 of its research on this region, the Center's activities are global, involving research from the Arabian Sea to the Yellowstone and from the poles to the tropics. UM-CES' scientists include biologists, ecologists, physicists, chemists, geologists, engineers, and economists who work together in a truly transdisciplinary community.



USACE Ecosystem Restoration Program [BOOTH #10]

WEB SITE: www.wes.army.mil/el

US Army Corps of Engineers REPRESENTATIVE: Dave Tazik (Dave.J.Tazik@usace.army.mil)

The Environmental Laboratory is the problem solver for the Corps and the Nation in environmental science and engineering research and development in support of environmental systems. The staff supports the environmental missions of the U.S. Army, the Department of Defense, and the Nation through research, development, special studies, and technology transfer. Environmental Laboratory research includes a network of expertise and facilities from other Engineer Research and Development Center (ERDC) and Corps Laboratories, other government agencies, academia, and private sector.



US Army Corps of Engineers [BOOTH #8 & 9]

WEB SITE: www.wes.army.mil

US Army Corps of Engineers **REPRESENTATIVE:** Roselle Henn (Roselle.E.Henn@usace.army.mil)

The United States Army Corps of Engineers is made up of military and civilian engineers, scientists and other specialists work hand in hand as leaders in engineering and environmental matters. Our diverse workforce of biologists, engineers, geologists, hydrologists, natural resource managers and other professionals meets the demands of changing times and requirements as a vital part of America's Army. The Corp's environmental mission has two major focus areas: restoration and stewardship. Efforts in both areas are guided by the Corps environmental operating principles, which help us balance economic and environmental concerns. We support or manage numerous environmental programs, that run the gamut from cleaning up areas on former military installations contaminated by hazardous waste or munitions to helping establish a small wetland that helps endangered species survive.



US Geological Survey [BOOTH #22 & 23]

WEB SITE: www.usgs.gov

REPRESENTATIVE: Ronnie Best (Ronnie_Best@usgs.gov)

The U.S. Geological Survey serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.



United States Department of Agriculture
Natural Resources Conservation Service

USDA Natural Resources Conservation Service [BOOTH #31 & 32]

WEB SITE: www.nrcs.usda.gov

REPRESENTATIVE: Philip Barbour (Philip.barbour@wdc.usda.gov)

Since 1935, the Natural Resources Conservation Service (originally called the Soil Conservation Service) has provided leadership in a partnership effort to help America's private land owners and managers conserve their soil, water, and other natural resources.



The Trusted Integrator for Sustainable Solutions

Weston Solutions [BOOTH #7]

WEB SITE: www.westonsolutions.com

REPRESENTATIVE: Cheryl Ulrich (Cheryl.Ulrich@westonsolutions.com)

Weston Solutions delivers integrated, sustainable solutions for environmental restoration, property redevelopment, design/build construction, green buildings and clean energy. Weston can help develop solutions to maximize the value of your resources and turn environmental responsibility into economic growth. We help clients restore productive assets to build a stronger economy and a healthier ecology.



Speaker Biographies

PLENARY SESSIONS

Monday, August 1, 2011

1:00pm – 3:00pm “Opening Plenary Session & Welcome Keynotes”

MODERATORS: Suzette Kimball, Deputy Director, US Geological Survey - and -
Don Boesch, President, University of Maryland Center for Environmental Science (UMCES)

Conference Co-Chairs

Dr. Suzette Kimball

Dr. Kimball became the Deputy Director of the U.S. Geological Survey in March 2010. Kimball was the Director of the Eastern Region in 2004 and became the Acting Associate Director for Geology in 2008.

She joined the USGS as Eastern Regional Executive for Biology. In that position, she built many partnerships, helped shape programs, and led the establishment of the USGS Florida Integrated Science Center. She came to the USGS from the National Park Service in Atlanta, where she was Associate Regional Director.



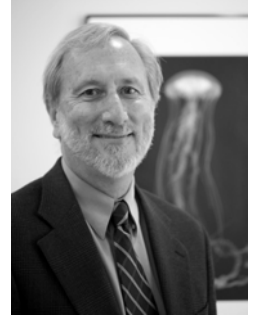
She entered the National Park Service as a research coordinator in the Global Climate Change Program, became Southeast Regional Chief Scientist, then Associate Regional Director. She was assistant professor of environmental sciences at the University of Virginia, co-director of the Center for Coastal Management and Policy and marine scientist at the Virginia Institute of Marine Science, and managed coastal morphology and barrier island studies in the U.S. Army Corps of Engineers.

She serves on executive boards and many State and national committees, including the Consortium for Coastal Restoration through Science & Technology, the Council of Examiners of the National Association of State Boards of Geology, and the DOI Senior Executive Service Advisory Council. She was on the board of directors of the Coastal Society and has served as secretary of the American Geophysical Union's Ocean Sciences Section.

She has authored numerous publications on barrier island dynamics, coastal ecosystem science, coastal zone management and policy, and natural resource exploration, evaluation and management. She has received the Presidential Rank Award and the Secretary of the Interior's Meritorious Service Award. Kimball has a doctorate in environmental sciences with a specialty in coastal processes from the University of Virginia, a master's in geology and geophysics from Ball State University, and a bachelor's in English and geology from the College of William & Mary.

Donald F. Boesch

Dr. Boesch is President of the University of Maryland Center for Environmental Science and also serves as Vice Chancellor for Environmental Sustainability for the 12-institution University System of Maryland. He earned his BS from Tulane University and PhD from the College of William and Mary and held faculty positions in Virginia and Louisiana before coming to Maryland in 1990.



An oceanographer who has conducted research on coastal and continental shelf ecosystems throughout the United States and in China and Australia, Dr. Boesch has focused much of his career on research and science-based management and restoration of Chesapeake Bay and the Mississippi Delta ecosystems.

In recent years he has also been engaged in national and regional assessments of the impacts of global climate change and was a contributing author to the 2009 report on Global Climate Change Impacts in the United States and the 2011 National Research Council report America's Climate Choices. Because of his experience on the Gulf Coast and knowledge of oil production impacts, Dr. Boesch was appointed by President Obama to the seven-member National Commission for the BP Deepwater Horizon Oil Spill and Offshore Drilling.

Welcome Keynote Speakers:

Martin O'Malley, Governor, State of Maryland

Kenneth Salazar, Secretary, Department of the Interior (invited)

Benjamin Cardin, Senator, State of Maryland

The Honorable Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works)

Gov. Martin O'Malley

Gov. O'Malley has been governor of Maryland since 2006. The Baltimore Sun credited O'Malley's administration with "accomplishing more in one year than most administrations accomplish in four." The Washington Post observed that Martin O'Malley is a "governor unafraid of government."



He served as Baltimore's mayor before being elected governor.

He attended the University of Maryland School of Law, and later became Assistant State's Attorney for Baltimore City, a member of the Baltimore City Council, and eventually Mayor of Baltimore City.

Martin O'Malley is a fearless, intelligent public servant. As Mayor of Baltimore City, he helped bring communities together to build a safer, cleaner and healthier city. Now, as Governor of the State of Maryland, he is applying his knowledge, experience and energy to making State government work again for the people. Martin O'Malley's administration has been credited with "accomplishing more in one year than most administrations accomplish in four," and he is driven by a belief that all citizens share certain core values and goals, and works tirelessly to unite the State as One Maryland.

Fourth National Conference on Ecosystem Restoration (NCER)

Kenneth Salazar

Salazar, a fifth-generation Coloradan, was confirmed as the 50th secretary of the U.S. Department of the Interior on Jan. 20, 2009, in a unanimous vote by the U.S. Senate.

Prior to his confirmation, Salazar served as Colorado's 35th U.S. senator, winning election in November 2004 and serving on the Finance Committee, which oversees the nation's tax, trade, social-security, and health-care systems. He also served on the Agriculture, Energy and Natural Resources, Ethics, Veterans Affairs and Aging committees.



As a U.S. Senator, Salazar was a leader in creating and implementing a vision for a renewable-energy economy that is less dependent on foreign oil. He was involved in every major bipartisan legislative effort on energy since 2005, including helping craft the Renewable Fuels, Consumer Protection, and Energy Efficiency Act of 2007.

From 1999 to 2004, Salazar served as Colorado's thirty-sixth Attorney General, winning statewide elections in 1998 and 2002. He chaired the Conference of Western Attorneys General and received the Profiles in Courage award from his fellow state attorneys general for his dedication to preserving and promoting the rule of law.

From 1987 to 1994 Salazar served in the Cabinet of Gov. Roy Romer as chief legal counsel and executive director of the Colorado Department of Natural Resources. There he crafted reforms for oil, mining, and gas operations to better protect the environment and the public. He fought to uphold Colorado's interstate water compacts, created the Youth in Natural Resources program to educate thousands of young people about Colorado's natural resources, and authored the Colorado constitutional amendment creating Great Outdoors Colorado. He served as the first chairman of that movement, helping make it one of the most successful land conservation efforts in the United States.

He received a political science degree from Colorado College in 1977, and graduated with a law degree from the University of Michigan in 1981. He also received honorary doctorates of law from Colorado College in 1993 and the University of Denver in 1999.

Benjamin L. Cardin

Cardin has been a national leader on health care, retirement security, the environment, and fiscal issues since coming to Congress in 1987. In 2006, he was elected to the U.S. Senate where he currently serves on the Environment and Public Works, Finance, Foreign Relations, Budget and Small Business & Entrepreneurship committees. In the 112th Congress, he chairs the Water and Wildlife Subcommittee of EPW and he chairs the International Development and Foreign Assistance, Economic Affairs and International Environmental Protection Subcommittee of the Foreign Relations Committee.



Support for the Chesapeake Bay has been one of Cardin's signature issues. In the 111th Congress, he authored the Chesapeake Clean Water and Ecosystem Restoration Act to reduce pollution and improve the health of the Chesapeake Bay through strong new enforcement tools and new grant authority. He also is a strong advocate for strengthening clean water protections, supporting increased funding for both traditional and innovative water infrastructure that can protect water quality.

From 1987 to 2006, Cardin represented Maryland's Third Congressional District in the U.S. House of Representatives. In addition to serving on the on the House Ways & Means Committee, he also served on the Budget Committee, Public Works & Transportation Committee, Judiciary Committee, Ethics Committee, House Administration and the Select Committee on Homeland Security. In the House, he also served as the senior Democrat on the Trade Subcommittee and Human Resources Subcommittee of the Ways & Means Committee.

In 1998, Cardin was appointed Chairman of the Special Study Commission on Maryland Public Ethics Law by the Maryland General Assembly. In 1997, he co-chaired the Bipartisan Ethics Task Force in an effort to reform ethics procedures in the U.S. House of Representatives.

Cardin is also a 1967 graduate of the University of Maryland School of Law, where he was 1st in his class. He also earned his B.A. degree in 1964 from the University of Pittsburgh. He holds honorary degrees from the University of Baltimore School of Law (1990); University of Maryland at Baltimore (1993); Baltimore Hebrew University (1994); Goucher College (1996); and Stevenson (formerly Villa Julie College), (2007).

For more information on Benjamin Cardin, U.S. Senator for Maryland, visit his website <http://cardin.senate.gov/>

Fourth National Conference on Ecosystem Restoration (NCER)

The Honorable Jo-Ellen Darcy

On August 11, 2009 President Barack Obama appointed Jo-Ellen Darcy as Assistant Secretary of the Army (Civil Works) following confirmation by the Senate. Prior to her appointment, Jo-Ellen Darcy was the Senior Environmental Advisor to the Senate Finance Committee, responsible for environment, conservation and energy issues.



As the assistant secretary, she establishes policy direction and provides supervision of the Department of the Army functions relating to all aspects of the U.S Army Corps of Engineers' Civil Works program, including all reimbursable work performed on behalf of Federal and non-Federal entities.

Previously, she was Senior Policy Advisor to the Senate Environment and Public Works Committee, concentrating on water resource and conservation issues involving the Army Corps of Engineers and the U.S Fish and Wildlife Service, as well as nominations for presidentially-appointed positions. At the start of the 107th Congress, she was the Deputy Staff Director for the EPW Committee. From 1993 through 2000, she served as a professional staff member on the EPW Committee, working on a variety of issues, including the Safe Drinking Water Act, Army Corps of Engineers programs, FEMA, Everglades restoration and the Clean Water Act.

Before joining the EPW Committee, Darcy was the legislative representative for the Investment Company Institute, the trade association representing the mutual fund industry. She worked on water resources and transportation issues for Governor Jim Blanchard of Michigan in both Lansing and Washington, D.C. Previously, she worked for the Subcommittee on Economic Stabilization of the House Banking Committee and was an elementary school teacher.

She is from Fitchburg, Massachusetts, and has a B.A. in philosophy and sociology from Boston College and a M.S. in resource development from Michigan State University.

Tuesday, August 2, 2011

8:30am – 10:00am “Plenary Session - Restoration Priorities”

MODERATOR: Don Boesch, President, University of Maryland Center for Environmental Science (UMCES)

Plenary Speakers:

The Honorable Robert Graham, Former Senator, State of Florida

Barry Gold, Program Director, Marine Conservation Initiative, Gordon & Betty Moore Foundation

Larry Schweiger, President and Chief Executive Officer, National Wildlife Federation

The Honorable Robert Graham

Senator Bob Graham is a former two-term governor of Florida and served for 18 years in the United States Senate. He has served 12 years in the Florida legislature for a total of 38 years of public service. As Governor and Senator, Bob Graham was a centrist, committed to bringing his colleagues together behind programs that served the broadest public interest. He was recognized by the people of Florida when he received an 83% approval ranking as he concluded eight years as Governor. Bob Graham retired from public service in January 2005, following his Presidential campaign in 2004.



Bob Graham is recognized for his leadership on issues ranging from healthcare and environmental preservation to his ten years of service on the Senate Select Committee on Intelligence — including eighteen months as chairman in 2001–2002. Following the release of the Joint Inquiry's final report in July 2003, Senator Bob Graham steadfastly advocated reform of the intelligence community and sponsored legislation to bring about needed changes. In the fall of 2004 Senator Bob Graham authored *Intelligence Matters* based upon his experiences gleaned during the joint inquiry and his analysis of the run up to the Iraq war.

After retiring from public life, Senator Bob Graham served for a year as a senior fellow at the Harvard Kennedy School of Government where he lectured to undergraduate, graduate and executive management students. His primary focus was on civic education and intelligence. These issues continue to be of great importance to Senator Bob Graham. He is currently researching and writing a book about civic participation, tentatively entitled *What Citizens Need to Know to Make Democracy Respond*; *Intelligence Matters* will be published as a paperback with updating in the fall of 2008.

Senator Bob Graham serves as the chair of the Board of Overseers of the Graham Center for Public Service. This Center, with a home at the University of Florida and the University of Miami, commenced programs in the fall of 2007 in the areas of Public Service, Homeland Security, and The Americas, subjects in which he has been deeply involved during his public career.

Barry Gold

Barry is Program Director for Marine Conservation at the Gordon and Betty Moore Foundation. Under his direction, the Foundation is advancing approaches to sustainable use of the ocean by addressing the impacts of the entire suite of activities occurring in a specific place, while integrating human use with conservation. They are also working toward sustainable fisheries by shifting management to an incentive-based system that research shows can end overfishing, rebuild depleted stocks, and sustain fishing communities. Barry is also seeking ways to advance and incorporate the concepts and tools of ecosystem services into ocean management.



Barry joined GBMF from the David and Lucile Packard Foundation where he led their efforts in marine ecosystem-based management. Before that he was chief of the Grand Canyon Monitoring and Research Center, one of the nation’s premier adaptive management programs. Here he was responsible for leading an effort to understand and protect some of the most highly prized scenic and natural resources in the nation while balancing potentially conflicting social, economic, and political interests and demands upon the resource.

Barry has held senior positions with the Department of the Interior, the U.S. House of Representatives, and the National Research Council. Barry currently serves as President of the Consultative Group on Biological Diversity; Vice-Chair of the California Ocean Science Trust; and as a member of the Advisory Board for the Collaborative Institute on Oceans, Climate and Security at UMASS – Boston. In 2007 he was elected a Fellow of the American Association for the Advancement of Science.

Larry Schweiger

Larry Schweiger is President and Chief Executive Officer of the National Wildlife Federation. He returned to the National Wildlife Federation in March 2004 with a commitment to confront the climate crisis and to protect wildlife for our children’s future.



Previously, Larry served for eight years as President and CEO of the Western Pennsylvania Conservancy, where he pioneered watershed restoration and promoted ecological research, land conservation and community outreach. Prior to that, Larry was the Executive Secretary of the Joint House/Senate Conservation Committee for the Pennsylvania General Assembly, Senior Vice President for Conservation Programs at National Wildlife Federation, and 1st Vice President of the Chesapeake Bay Foundation.

Larry is an active community leader, having served on more than 40 governing boards, commissions and committees. He currently serves on the Boards of Directors of the Alliance for Climate Protection; the Climate Protection Action Fund; the H. John Heinz III Center for Science, Economics and the Environment; BlueGreen Alliance; and National Wildlife Federation Action Fund. He was selected as Pennsylvania’s Environmental Professional of the Year in 2002, Pittsburgher of the Year in 2000, and he received a Conservation Service Award from the Christian Environmental Association in September 1995.

Thursday, August 4, 2011

8:30am – 10:00am “Plenary Session - Linking Land and Ocean”

MODERATOR: Suzette Kimball, Deputy Director, US Geological Survey

Plenary Speakers:

Larry Robinson, Assistant Secretary for Commerce for Oceans and Atmosphere, NOAA

Kameran Onley, Director of US Marine Policy, The Nature Conservancy

Dave White, Chief, USDA Natural Resources Conservation Service (NRCS)

Larry Robinson

Larry Robinson was confirmed by the United States Senate as Assistant Secretary for Conservation and Management at the National Oceanic and Atmospheric Administration on May 6, 2010. Prior to this appointment Robinson served as the Vice President for Research at Florida A&M University (FAMU).



In 2007, Robinson became the first African American to serve as Science Advisor to the United States Department of Agriculture’s Cooperative State Research, Education, and Extension Service where he served until 2009. In 2008 Robinson was selected to serve on the Oceans Research and Resources Advisory Panel and as a founding member of the National Science Foundation’s National Ecological Observatory Network Science Technology Education Advisory Committee. Robinson also served as a research scientist and group leader at Oak Ridge National Laboratory from 1984 to 1997.

Robinson has served as chair of the Biology and Medicine Division of the American Nuclear Society; charter member of the Council of Environmental Deans and Directors; and treasurer and executive board member of the East Tennessee Chapter of the National Organization of Black Chemists and Chemical Engineers.

Through volunteer and professional activities Robinson has been a staunch supporter of education at the post-secondary level and has shown a career-long commitment to increasing the participation of underrepresented groups in science, technology, engineering and mathematics (STEM). Through his research efforts Robinson has served as major research advisor to several M.S. and Ph.D. degree recipients in Environmental Science at FAMU.

He attended LeMoyne-Owen College in 1975, graduated summa cum laude with a B.S. degree in chemistry from Memphis State University in 1979, and earned a Ph.D. degree in nuclear chemistry from Washington University in St. Louis in 1984.

Fourth National Conference on Ecosystem Restoration (NCER)

Kameran Onley

Onley is the Director of U.S. Marine Policy, The Nature Conservancy. She leads the Conservancy's engagement with Congress, Federal agencies, and partners to achieve the Conservancy's marine conservation goals as the world's largest science-based ocean conservation organization.



Prior to joining the Nature Conservancy, Onley served as Associate Vice President with PBS&J, Inc. where she lead projects for the Department of the Interior (DOI) and National Oceanographic and Atmospheric Administration (NOAA) in the management of restoration of national resources.

She has also held positions as the acting Assistant Secretary for Water and Science at DOI, Associate Director for Environmental Policy at the White House Council on Environmental Quality, Associate Director for the Regulatory Studies Program at the Mercatus Center, and Manager for Environmental Policy Issues for Koch Industries and the Charles G. Koch Charitable Foundation.

Dave White

White was named Chief of the Natural Resources Conservation Service on March 24, 2009. He began his 33-year career with the Natural Resources Conservation Service (NRCS) as a conservation aid in Missouri. Subsequently, he has served the agency in South Carolina, Montana and its Washington, D.C. headquarters. As Chief, he leads 12,000 employees and manages a budget in excess of \$4 billion.



From 2002 to 2008, Mr. White was assigned as the NRCS State Conservationist in Montana. For much of 2007 and 2008, he was also detailed to Senator Tom Harkin's Capitol Hill office, where he helped the Senate Committee on Agriculture; Nutrition & Forestry craft the Conservation Title of the 2008 Farm Bill. His earlier jobs in the Washington, D.C. area include two details to the staff of Senator Richard Lugar, in support of agriculture committee work on energy and alternative fuels and the 2002 Farm Bill, and a tour in the White House Task Force for Livable Communities.

Mr. White is an honors graduate of the University of Missouri, where he studied agriculture. NRCS provides leadership in a partnership effort to help America's private land owners and managers conserve their soil, water, and other natural resources.

Friday, August 5, 2011

10:30am – 12noon “Closing Plenary Session -Restoration After the Deepwater Horizon Oil Spill”

MODERATOR: Suzette Kimball, Deputy Director, US Geological Survey

Plenary Speakers:

Lisa Jackson, Administrator, US Environmental Protection Agency (EPA)

Garret Graves, Chair, Coastal Protection and Restoration Authority of Louisiana (CPRA)

Don Boesch, President, University of Maryland Center for Environmental Science (UMCES)

Administrator Lisa Jackson

Lisa P. Jackson currently works for the United States Environmental Protection Agency as the EPA Administrator. She leads EPA’s efforts to protect the health and environment for all Americans. She and a staff of more than 17,000 professionals are working across the nation to usher in a green economy, address health threats from toxins and pollution, and renew public trust in EPA’s work.



As Administrator, Jackson has pledged to focus on core issues of protecting air and water quality, preventing exposure to toxic contamination in our communities, and reducing greenhouse gases. She has promised that all of EPA’s efforts will follow the best science, adhere to the rule of law, and be implemented with unparalleled transparency.

Jackson is the first African-American to serve as EPA Administrator. She has made it a priority to focus on vulnerable groups including children, the elderly, and low-income communities that are particularly susceptible to environmental and health threats. In addressing these and other issues, she has promised all stakeholders a place at the decision-making table.

Before becoming EPA’s Administrator, Jackson served as Chief of Staff to New Jersey Governor Jon S. Corzine and Commissioner of the state’s Department of Environmental Protection (DEP). Prior to joining DEP, she worked for 16 years as an employee of the U.S. EPA. Jackson is a summa cum laude graduate of Tulane University and earned a master’s degree in chemical engineering from Princeton University.

Garret Graves

Graves is currently the Chair of the Coastal Protection and Restoration Authority of Louisiana (CPRA). The CPRA was established after Hurricane Katrina as the state agency leading hurricane protection, flood control, ecosystem restoration and other community resiliency efforts.



His efforts to restructure and streamline Louisiana’s coastal programs and agencies resulted in increasing output by more than 500 percent. The authority currently oversees a \$17 billion coastal resiliency and hurricane protection program.

Prior to joining the State of Louisiana, Mr. Graves served for 13 years as a policy advisor to Senator John Breaux, Congressman Billy Tauzin, as well as the Senate Commerce, Science and Transportation Committee and the House Energy and Commerce Committee. During this time, he advised Members of Congress on energy, environment, water resources, transportation, maritime, defense, trade, foreign affairs, and budget issues. Mr. Graves was also staff director of the U.S. Senate Subcommittee on Climate Change and Impacts.

Following the 2010 Deepwater Horizon Oil Spill, he was appointed as lead trustee for the Natural Resources Damage Assessment process and directs the state’s oil spill recovery efforts.

COFFEE HOUSE SESSIONS

Tuesday, August 2, 3:30-5:00 pm

Can Chesapeake Bay Restoration Be Accomplished?

It has been 28 years since the first agreement to restore the Chesapeake Bay ecosystem and despite substantial and sustained efforts goals have not been met. The effort recently entered a new phase with legal requirements to implement programs to meet TMDLs, yet the path is steep. Can the Chesapeake Bay restoration goals ever be fully met and what changes are needed to achieve this?

Jeff Corbin, Senior Advisor to the Administrator, U.S. Environmental Protection Agency

Will Baker, President, Chesapeake Bay Foundation

Ann Swanson, Executive Director, Chesapeake Bay Commission

Robert Summers, Secretary, Maryland Department of the Environment

Moderator: Tim Wheeler, reporter, *Baltimore Sun*

Jeff Corbin is the new senior adviser for the Environmental Protection Agency's effort to restore and preserve the Chesapeake Bay. In his new position, Jeff will help coordinate all aspects of the strategic Chesapeake Bay. He will serve as the chief liaison among the Office of the Administrator; federal, state and local government partners; community and nonprofit stakeholders; and our colleagues throughout the EPA.



Before joining Region 3 in January 2010, Jeff was appointed assistant secretary of natural resources for the Commonwealth of Virginia by then-Governor Tim Kaine. Earlier, he spent almost a decade with the Chesapeake Bay Foundation, ultimately serving as its Virginia deputy director and senior scientist. Jeff also worked as an environmental geologist and water quality specialist for the Texas Natural Resource Conservation Commission during the early 1990s.

He has a B.A. in Marine Science from the University of South Carolina, and a M.S. in Oceanography from the University of Rhode Island. Jeff is a Coast Guard-licensed small vessel captain and a certified scuba diver with 30 years of experience.

Will Baker has dedicated his entire career to saving Chesapeake Bay, and leading the largest non-profit conservation organization dedicated solely to it.



After graduation from Trinity College in 1976, Baker came to work for the Chesapeake Bay Foundation as an intern at the request of one of CBF's trustees. Mr. Baker became the President and Chief Executive Officer of CBF in 1982.

CBF has a \$22 million annual operating budget and is supported by 200,000 members from every state in the Union and 14 foreign countries. CBF is staffed by 160 full-time employees who operate out of state offices in Maryland, Pennsylvania, Virginia and Washington, DC as well as 16 separate environmental education centers. CBF's education centers engage approximately 40,000 students and teachers in hands-on field experiences annually.

In recognition of CBF's environmental education program, the organization received the 1992 Presidential Medal for Environmental Excellence, which is the nation's highest environmental honor.

Ann P. Swanson serves as Executive Director of the Chesapeake Bay Commission, a tri-state legislative advisory authority composed of legislators, cabinet secretaries and citizens from Maryland, Virginia and Pennsylvania. The Commission is a signatory to the Chesapeake Bay agreements and coordinates Bay restoration activities among the state legislatures and the U.S. Congress. Ann has been a leader in the region for more than twenty years.



Ann has been recognized as the University of Vermont Outstanding Alumni of the Year in 1989, received the Chesapeake Executive Council Salute to Excellence Award in 1992 and again in 1999, the Chesapeake Bay Foundation's 2001 Conservationist of the Year, and most recently, the Sierra Club's Award for Outstanding Achievement in 2004. Ann has an undergraduate degree in Wildlife Biology from the University of Vermont and a graduate degree in Environmental Science from Yale University, where she graduated with high honors. Ann has chaired the Board of the University of Vermont's School of Natural Resources Advisory Council for the past 11 years.

Robert M. Summers was appointed Secretary of the Maryland Department of the Environment by Governor Martin O'Malley on April 28, 2011. Summers leads the Department's planning, regulatory, management, and financing programs to protect public health, ensure a safe and reliable water supply, restore and protect air quality, water quality, wetlands and waterways, clean up contaminated land and ensure proper management of hazardous and solid wastes.



Throughout his career, Summers has been a key contributor to the Chesapeake Bay restoration effort. He has served the citizens of Maryland for 27 years in various capacities within Maryland's progressive and nationally recognized environmental programs.

Summers received his B.A. and Ph.D. in Environmental Engineering from the Johns Hopkins University. Prior to joining Maryland's environmental programs, he worked as a research assistant at the Johns Hopkins University's Chesapeake Bay Institute and as a post-doctoral research associate at the State University of New York, Marine Sciences Research Center in Stony Brook, NY.

Tim Wheeler is a reporter covering the Chesapeake Bay and other environmental issues in Maryland and beyond. He is Chief contributor to B'more Green blog. He covers air pollution, algae, endangered species, fisheries, forests, greenhouse gases, green building, solar, wind, and water.



Wheeler is a former president of the Society of Environmental Journalists, and a current board member. He has a B.A. in Economics from the University of Virginia and a M.S. in Journalism from Columbia University.

In his 25 years at The Baltimore Sun, he's also covered growth and development, state and local government, and higher education. Before joining the Sun, he worked for a regional news service in Washington, D.C., and newspapers in Norfolk and Richmond, Va.

Thursday, August 4, 3:30-5:00 pm

Effective Communication of the Ecosystem Restoration Challenge

Public and political support is essential for ecosystem restoration, yet restoration scientists and practitioners are often ill prepared for communicating objectives and requirements. Most communication takes place through the news media rather than talks and pamphlets. An exceptionally experienced panel of reporters and authors will discuss what the public needs to know and how media changes affect communications pathways and offer some tips on how restoration scientists and practitioners can more effectively communicate.

David Fahrenthold, Congressional reporter for the *Washington Post*
Tom Horton, author of *Turning the Tide: Saving the Chesapeake Bay*
Christopher Joyce, environment reporter for National Public Radio
Chris Mooney, author of *Unscientific America* and blogger at The Intersection
Moderator: Terence Smith, special correspondent *PBS News Hour* (invited)

David Fahrenthold is a Houston native who graduated from Harvard University in 2000. A reporter for the Washington Post, he covered regional environmental issues, including the Chesapeake Bay restoration, for several years. He wrote several front page stories on the accuracy of assessment of progress by the Chesapeake Bay Program. His coverage then expanded to include national and international environmental issues, including global climate change, mountaintop mining, and last year's BP Deepwater Horizon oil spill. In December, 2010, the Post "elevated" him to become a principal correspondent for coverage of Congress.



Tom Horton worked for five years as an educator at the Chesapeake Bay Foundation, where he wrote *Turning the Tide*, a book on solutions to the Chesapeake's water quality problems.

Horton covered environmental issues for the Baltimore Sun from 1974 until 2006. He is author of several books about Chesapeake Bay and has written for magazines including National Geographic, Rolling Stone, The New York Times, and the Boston Globe.



He teaches writing and environmental studies at Salisbury University, and contributes regularly to Chesapeake Bay Magazine and the Bay Journal News Service. He is currently writing a book on chickens for WW Norton publishers.

He recently paddled his kayak 550 miles around the Delmarva Peninsula and is planning to ride his bike across the U.S. in 2008.

Christopher Joyce is a correspondent on the science desk at National Public Radio. His stories can be heard on all of NPR's news programs, including NPR's Morning Edition, All Things Considered, and Weekend Edition.



Joyce seeks out stories in some of the world's most inaccessible places. He has reported from remote villages in the Amazon and Central American rainforests, Tibetan outposts in the mountains of western China, and the bottom of an abandoned copper mine in Michigan's Upper Peninsula.

Joyce came to NPR in 1993 as a part-time editor while finishing a book about tropical rainforests. For two years, Joyce worked on NPR's national desk and was responsible for NPR's Western coverage.

Joyce's stories on forensic investigations into the massacres in Kosovo and Bosnia were part of NPR's war coverage that won a 1999 Overseas Press Club award. He was also part of the Radio Expeditions reporting and editing team that won the 2001 Alfred I. duPont-Columbia University journalism award and the 2001 Sigma Delta Chi award from the Society of Professional Journalists. Joyce also won the 2001 American Association for the Advancement of Science excellence in journalism award.

Chris Mooney is a free lance writer who focuses on science and politics. Mooney is host of the Point of Inquiry podcast and the author of three books, *The Republican War on Science*, *Storm World*, and his most recent publication, *Unscientific America*. He also writes a science blog called "The Intersection" which was a recipient of Scientific American's 2005 Science and Technology web award. He was recently seen on MSNBC's "The Last Word" discussing "The Science of Why We Don't Believe Science," and recently wrote for The American Prospect magazine about how the reality-based community is moving to the left.



Chris has been featured regularly by the national media. He has appeared on The Daily Show with Jon Stewart, The Colbert Report, MSNBC's "Morning Joe," CSPAN's Book TV, and NPR's Fresh Air With Terry Gross and Science Friday.

Mooney's book *The Republican War on Science* was named a finalist for the 2005 Los Angeles Times book prize in the category of "Science and Technology." His 2005 feature story about ExxonMobil, conservative think tanks, and climate change was nominated for a National Magazine Award in the "public interest" category.

Mooney graduated from Yale University in 1999. Before becoming a freelance writer, Chris worked for two years at The American Prospect as a writer, staff writer, then online editor.

Fourth National Conference on Ecosystem Restoration (NCER)

Terence Smith is an award-winning journalist who has been a political reporter, foreign correspondent, editor and television analyst over the course of a 40-year career. He has written on everything from a Bedouin wedding in the Sinai to firefights in the jungles of Vietnam.



Smith began his career covering local politics at the Stamford (CT) Advocate. He spent 20 years with The New York Times, including eight years abroad in the Middle East and Far East, covering four wars, peace negotiations and the day-to-day lives of people in more than 40 countries. Smith's coverage earned two Pulitzer Prize nominations and numerous other awards. He won the Times' Publisher's Prize for outstanding writing 22 times

In 1985, Smith joined CBS News in Washington, covering the Reagan White House and for nine years, reporting the cover stories for CBS Sunday Morning. He earned two Emmys for his work on the broadcast "48 Hours."

In 1998, Smith turned to public television, founding and leading the media unit at The NewsHour with Jim Lehrer. In the course of seven years, Smith and his unit won 18 national awards and honors for media criticism and analysis. In the fall of 2005, the media unit grant ended, and Smith opted to become a freelance writer and essayist for a number of news organizations.

Smith is a frequent guest host for The Diane Rehm Show on National Public Radio. He speaks, writes, and broadcasts on national politics, international affairs, and environmental issues involving the Chesapeake Bay and ocean policies.

For more information on Terence Smith, visit his website. <http://terencefsmith.com/>

Agenda-at-a-Glance

Monday, August 1, 2011

7:30am-5:30pm	Registration Office Open (Level Three)
7:30am-12:30pm	Session I Posters and Exhibitors Move-In—Exhibit Hall (Grand Ballroom, 3 rd Floor)
8:30am-12:00pm	OPTIONAL Pre-Conference Technical Training Workshops
12:00pm-1:00pm	LUNCH ON OWN
1:00pm-3:00pm	Plenary Session & Welcome by Keynote Speakers (Harborside Ballroom, 4 th Floor)
3:30pm-5:00pm	Concurrent Sessions
5:00pm-6:00pm	PLENARY SOCIAL - The Future of NCER (Harborside Ballroom, 4 th Floor)
6:00pm-8:00pm	WELCOME RECEPTION—Baltimore National Aquarium

Tuesday, August 2, 2011

7:30am-8:30am	Early Morning Refreshments –Exhibit Hall (Grand Ballroom, 3 rd Floor)
8:30am-10:00am	Plenary Session - National Ecosystem Restoration Priorities (Harborside Ballroom, 4 th Floor)
10:30am-12:00pm	Concurrent Sessions
12:00pm-1:30pm	LUNCH ON OWN
1:30pm-3:00pm	Concurrent Sessions
3:30pm-5:00pm	Restoration Coffee House Plenary (Harborside Ballroom, 4 th Floor)
5:00pm-6:00pm	Plenary "USGS Listening Session" with State & Federal Agency Representatives (Harborside Ballroom, 4 th Floor)
6:00pm-8:00pm	Formal Poster Session I & Networking Reception—Exhibit Hall (Grand Ballroom, 4 th Floor) <i>(Upon conclusion, Session I presenters remove posters)</i>

Wednesday, August 3, 2011

7:00am-8:00am	Early Morning Refreshments & Session II Posters Move-In—Exhibit Hall (Grand Ballroom, 3 rd Floor)
8:00am-11:30am	Concurrent Sessions
11:30am	OPTIONAL Technical Field Trips
11:30am-7:00pm	Optional Field Trips, Ad Hoc Meetings and Free Time

Fourth National Conference on Ecosystem Restoration (NCER)

Thursday, August 4, 2011

7:30am-8:30am	Early Morning Refreshments— Exhibit Hall (Grand Ballroom, 3rd Floor)
8:30am-10:00am	Plenary Session – Linking Land and Oceans (Harborside Ballroom, 4th Floor)
10:30am-12:00pm	Concurrent Sessions
12:00pm-1:30pm	LUNCH ON OWN
1:30pm-3:00pm	Concurrent Sessions
3:30pm-5:00pm	Restoration Coffee House Plenary (Harborside Ballroom, 4th Floor)
5:30pm-7:30pm	Formal Poster Session II & Networking Reception— Exhibit Hall (Grand Ballroom, 3rd Floor)

Friday, August 5, 2011

7:30am-8:30am	Early Morning Refreshments— Exhibit Hall (Grand Ballroom, 3rd Floor)
8:30am-10:20am	Concurrent Sessions
10:30am-12:00pm	CLOSING PLENARY SESSION (Harborside Ballroom, 4th Floor)
12:00pm	Conference Concludes
10:30am-2:00pm	Exhibitors & Session II Posters Move-Out— Exhibit Hall (Grand Ballroom, 3 rd Floor)

Program Agenda

MON 8/1	MONDAY, AUGUST 1, 2011							
7:30-5:30	Conference Registration Open (3rd Floor at top of Escalator)							
7:30	Morning Refreshments and Poster Session Presenters & Exhibitors MOVE-IN to Set-Up Displays (Exhibit Hall - Grand Ballroom - 3rd Floor)							
8:30-12:00	OPTIONAL PRE-CONFERENCE WORKSHOPS (Consult the program book for meeting room locations if you registered for one of these workshops.)							
12:00	Lunch on Own							
1:00-3:00	<p>OPENING PLENARY SESSION (Harborside Ballroom - Level 4)</p> <p>Moderators: Suzette Kimball, Deputy Director, US Geological Survey - and - Don Boesch, President, University of Maryland Center for Environmental Science (UMCES)</p> <p>Plenary Speakers: Martin O'Malley, Governor, State of Maryland Kenneth Salazar, Secretary, Department of the Interior (invited) Benjamin Cardin, Senator, State of Maryland The Honorable Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works)</p>							
3:00	Refreshment Break (Exhibit Hall - 3rd Floor Grand Ballroom)							
3:30-5:00	CONCURRENT SESSIONS							
	Challenges & Lessons Learned: Everglades, Louisiana Coastal Area and Great Lakes Restoration	Regulatory Pollution Diet for the Six-State Chesapeake Bay Watershed	Ecosystem Services: Integrating Ecology and Economics	Integration of Science and Engineering I	Coastal Habitat Restoration	Adaptive Management toward Restoration Objectives	Urban Ecosystem Restoration	Riverine Recovery
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	Cheryl Ulrich	Richard Batiuk	Carl Shapiro	Ricardo Calvo	Robert Pace	Katelyn Lynch	Mark Jaworski	Chris Weber
3:30-3:40	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
3:40-4:00	Moderated Panel Discussion: Lessons learned related to improved cooperation at State and Federal levels in dealing with implementation and political challenges of large-scale restoration.	Gary Shenk Components of the Chesapeake Bay TMDL	Stephen Faulkner Integrated Modeling Framework for Forecasting Ecosystem Services	Jon Hendrickson Island Construction-Rebuilding Natural Levees to Restore Hydrologic Connectivity	Bowdoin Lusk Restoring Functional Oyster Reef Habitat in the Coastal Bays of Virginia	Andrew Tyre Under What Conditions Might Ecologists Provide Evidence that Influences Decision Making?	Brian Murphy A Past River for a Future Arizona – Salt River Environmental Restoration Project: Rio Salado Oeste Reach	Mark McKinstry Recovering Endangered Fish in the San Juan River—Snatching Success From the Jaws of Nonnative Fish
4:00-4:20		Jeni Keisman Not All Loads Are Equal: Assigning Regional Pollutant Reductions in a Multi-State TMDL	Richard Bernknopf Estimating the Supply of Ecosystem Services for a Carbon Resource Assessment	Mike Collis Integration of Science and Engineering into Innovative Ecosystem Restoration Concepts for the CERP C-111 Spreader Canal Western Project	Robert Orth Seed Addition Facilitates Eelgrass (<i>Zostera marina</i> L.) Recovery in a Coastal Lagoon System (USA)	Jim Vearil Use of Robustness and Flexibility in Adaptive Management for Addressing Uncertainty	John O'Meara Improving an Urban Ecosystem for Recreational Uses: The Carpenter Lake Restoration Project	Charles Young Case Study: Riparian Habitat Restoration for Improved Water Quality and Habitat in Highly Developed Suburban Watershed, West Whiteland Township Park, Exton, PA

Fourth National Conference on Ecosystem Restoration (NCER)

MON 8/1	MONDAY, AUGUST 1, 2011 (continued)							
4:20-4:40	<p>Panel members: Kim Taplin (USACE WPB Deputy Program Manager for Restoration)</p> <p>Larry Gerry (SFWMD Chief Scientist & STA Issues Coordinator)</p> <p>Mark Wingate (USACE New Orleans Chief Projects Branch)</p> <p>Bren Haase (LA OCP, Planning Section)</p>	<p>Katherine Antos A Roadmap and Weigh Stations: Creating an Accountability System for Implementing a Multi-Jurisdictional TMDL in the Chesapeake Bay Watershed</p>	<p>Darius Semmens Assessment of Goods and Valuation of Ecosystem Services (AGAVES) in the San Pedro River Basin, Arizona and Mexico</p>	<p>David Smith Choosing One Stream Restoration Alternative Among Many</p>	<p>Morris Perot Habitat Improvements to the Motor Island Shoreline in the Upper Niagara River, NY: A Collaborative Approach</p>	<p>Dan Salas Urban Coastal Wetland Restoration Planning in America's Birthplace: Lessons from the John Heinz NWR and 300 Years of Urbanization</p>	<p>Jill Stachura Urban Ecosystem Restoration: An Example of Stream and Lake Restoration in Metropolitan Atlanta, GA</p>	<p>Christopher Svendsen Yellowstone River — Intake Dam Fish Passage and Entrainment Prevention</p>
4:40-5:00	<p>Jan Miller (USACE ORD, Great Lakes Coordinator) and</p> <p>David Ullrich (Executive Director, Great Lakes and St. Lawrence Cities Initiative)</p>	<p>Jennifer Volk Delaware's Role in Restoring the Chesapeake Bay</p>	<p>Jonathan Winsten Increasing the Cost-Effectiveness of Maryland's Cover Crop Program on the Eastern Shore</p>	<p>Larry Gerry Everglades Stormwater Treatment Areas: Two Decades of Integrating Science and Engineering for Ecosystem Restoration</p>	<p>Eric Swain Estimation and Prediction of Coastal Landscape Changes Utilizing a Hydrodynamic Simulator and Aerial Photogrammetry</p>	<p>Timothy Fleeger Big Muddy Metrics: Adaptive Management on the Missouri River</p>	<p>Mike Fowler Comprehensive Watershed Planning for Nutrient Reduction in Ellerbe Creek, Durham, NC</p>	<p>Douglas Baughman Chattahoochee River Dam Removal and Ecosystem Restoration Project: Meeting Ecosystem Restoration and Recreation Goals</p>
5:00	<p>PLENARY SOCIAL - The Future of NCER Join us for refreshments in Harborside Ballroom on the 4th Floor to discuss the Future of NCER.</p>							
7:00-9:00	<p>Welcome Reception at the National Aquarium in Baltimore (Participants will walk to the nearby Baltimore Aquarium for a beautiful evening in aquatic surroundings.)</p>							
TUES 8/2	TUESDAY, AUGUST 2, 2011							
7:30-5:30	<p>Conference Registration Open</p>							
7:30-8:30	<p>Morning Refreshments in Exhibit Hall (Grand Ballroom - 3rd Floor)</p>							
8:30-10:00	<p>Plenary Session – Restoration Priorities (Harborside Ballroom - Level 4)</p> <p>Moderator: Don Boesch, President, University of Maryland Center for Environmental Science (UMCES)</p> <p>Plenary Speakers: The Honorable Robert Graham, Former Senator, State of Florida Barry Gold, Program Director, Marine Conservation Initiative, Gordon & Betty Moore Foundation Larry Schweiger, President and Chief Executive Officer, National Wildlife Federation</p>							
10:00-10:30	<p>AM Break in Exhibit Hall (Grand Ballroom - 3rd Floor)</p>							

TUES 8/2	TUESDAY, AUGUST 2, 2011 (continued)							
10:30-12:00	CONCURRENT SESSIONS							
	Establishing Successful Science/ Policy Linkages	Climate Change Impacts on Chesapeake Bay Restoration	Principles and Guidelines for Water Resources Planning and Implementation	Governance and Management Decision Making	USDA NRCS Mississippi River Basin Healthy Watershed Initiative	Our Resilient Waterways: Balancing Urban Growth While Maintaining Sustainable Ecosystems	Lake Restoration	Incorporating Invasive Species Management in Ecosystem Restoration
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	Matt Harwell	Kevin Sellner	Dave Tazik	Dennis Kamber	Danielle Flynn	Andrew LoSchiavo	Chris Ross	Bill Zattau
10:30-10:40	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
10:40-11:00	Matt Harwell & John Ogden This session addresses the issue of establishing successful linkages between policy and science in restoration efforts. A panel of experts involving both	Raymond Najjar Potential Climate Change Impacts on the Chesapeake Bay	Robyn Colosimo, PE, Deputy Associate Director of Natural Resources, Council on Environmental Quality, will address the process of revising the P&G; policy, science and engineering issues, and emerging procedural guidelines and methodologies; P&G background, principles of modernization, an overview of the process, public comment perspectives, writing and vetting; she will also present results to date and status of the signed P&G, and applicability and guidelines under public review. Audience Q&A will follow.	Pervaze Sheikh Implementation and Governance of Large-scale Ecosystem Restoration Initiatives: A Congressional Perspective	Thomas Christensen Overview of the Mississippi River Basin Healthy Watersheds Initiative (MRBI)	Wolfgang Wolter Balancing Competing Priorities in an Urban Creek Restoration in Toronto Ontario Canada	Andrew Hannes Benthic Ecological Assessment for the Great Lakes Method	Matthew Shanks Interagency Monitoring of Bighead and Silver Carp in the Upper Illinois River and Chicago Area Waterways
11:00-11:20	scientists and policy makers will: 1) discuss current challenges seen in restoration practices; 2) explore proposed mechanisms to improve linkages; and 3) outline next steps beyond NCER dialogue, followed by structured Q&A.	Robert Wood Using Historic Analogy to Evaluate How Future Climate Changes May Affect Chesapeake Bay and its Restoration Trajectory		Igor Linkov Decision Analysis and Ecosystem Restoration: Framework and Application Case Studies	Robert Kellogg The Effects of Conservation Practices on Environmental Quality in the Upper Mississippi River Basin	David Gorman Lower Columbia River Pile Dike Assessment	Tim Fobes Improving NEPA Alternatives Documentation for Objective Decision Making in Ecosystem Restoration and Endangered Species Recovery on the Missouri River: The Benedictine Bottoms Case Study	Dave Wethington The Great Lakes & Mississippi River Interbasin Study (GLMRIS)
11:20-11:40		William Stiles Developing a "Toolkit" for Climate Change Adaptation in Virginia's Tidal Shoreline Communities		Kenneth Mierzwa Restoration Policy: A City Council Perspective	Mike Sullivan A Progress Report for Mississippi River Basin Healthy Watersheds Initiative Implementation in Arkansas	Kathryn Barnicle Ups and Downs of a Salt Marsh Restoration Project in an Urban Setting	Carla Duncan Lake Rehabilitation Options for the Machado Lake Ecosystem Rehabilitation Project	Jon Lane Everglades Restoration, Swamped by Invasive Species
11:40-12:00		Gary Shenk Downscaled Regional Climate Models and Future Chesapeake Bay Loads		Jessica Weatherby How to Proceed with Restoration Construction When Agricultural Chemicals Pose Ecological Bioaccumulation Concerns	Trey Cooke Mississippi River Basin Healthy Watersheds Initiative: Impacts in the Yazoo Basin	Steve Wolf Balancing the Development and Maintenance of Waterways with Ecosystem Protection and Restoration	Nick Jokay Geomorphological Interpretation of High Resolution DEMs from the GIS Desktop: A Case Study	Ondrea Hummel Invasive Species Management in the Southwestern United States
12:00-1:30	Lunch on Own							

Fourth National Conference on Ecosystem Restoration (NCER)

TUES 8/2	TUESDAY, AUGUST 2, 2011 (continued)							
1:30-3:00	CONCURRENT SESSIONS							
	Comparison and Contrast of Six Large-scale Ecosystem Restoration Programs	Lessons Learned and New Opportunities for Restoring Water Quality in Chesapeake Bay	Approaches to Environmental Benefits Assessment	Integration of Science and Engineering II	Ecosystem Restoration with Private Landowners through Partnerships	Decision Support Tools to Establish Restoration and Preservation Priorities	Restoring the New York Harbor Estuary	Invasive Species
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	Brad Thompson	Peter Tango	David Escude	Tim Feather	Philip Barbour	David Hanson	Lisa Baron	Dave Koran
1:30-1:40	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
1:40-2:00	This session provides a forum for comparison and contrast of a number of the nation's largest ecosystem restoration efforts. <ul style="list-style-type: none"> Chesapeake Bay Program Frank Dawson 	Denice Wardrop Water Quality Challenges in the Chesapeake Bay – The Science Dimension	Barbara Cintron Calculating Environmental Benefits: Goals, Performance Measures, Performance Targets and Habitat Units	Eliza Hines The Real World – Merging Science and Engineering for Ecosystem Restoration	Danielle Flynn NRCS National Sage Grouse Initiative: Focused Working Lands Conservation	Joe DePinto Evolution of Modeling Tools to Support Management and Restoration of the Great Lakes	Peg McBrien Urban Wetland and Stream Restoration in the Hudson-Raritan Estuary	Alfred Cofrancesco Restoration of Wetland Habitats Dominated by <i>Phragmites australis</i>
2:00-2:20	<ul style="list-style-type: none"> Coastal Louisiana Area Greg Miller Everglades Restoration Stu Appelbaum Missouri River Recovery Program Brad Thompson 	Rich Batiuk Putting the 17 Million Chesapeake Bay Watershed Residents on a Regulatory Pollution Diet	Bruce Pruitt Development and Application of a Piedmont Stream Conceptual Model	Wendy Katagi Restoration Opportunities Spurred by Steelhead Recovery in Southern California	Dale Humburg Wetland Restoration on Private Lands: Changing Perspectives and Future Challenges	Willis McConnaha Use of a Medical Model to Diagnose and Treat Ecological Systems	Terry Doss Restoring Coastal Habitat in the Heart of New York City	Mark Lewandowski Management Strategies for Water Chestnut (<i>Trapa natans</i>): A Historical Perspective
2:20-2:40	<ul style="list-style-type: none"> California Bay Delta Tom Kendall Upper Mississippi River Ken Barr 	Scott Phillips Applying Adaptive Management to Improve Water-Quality Decision Making: Implications for Restoring the Nation's Largest Estuary-Chesapeake Bay	Joe Berg Prioritizing Watershed Restoration: Headwater Versus Downstream Projects	Wayne Nelson-Stasty Development of the Natural Resource Baseline Assessment for the Missouri River Ecosystem Restoration Plan	Trey Cooke Partnerships Driving Ecosystems Restoration on Private Lands in the Yazoo Basin	Denise Reed Using Science to Inform Decision Making in the Face of Uncertainty: A Tool for Prioritizing Coastal Restoration and Protection Projects in Louisiana	Roy Messaros The Sustainability of a Tidal Salt Marsh Restoration Effort in Jamaica Bay, New York	William Holman Applying Engineering Solutions to the Science of Invasive Aquatic Species Control – Asian Carp and Sea Lamprey
2:40-3:00		Vicki Blazer Toxic Chemicals and Fish Health in Chesapeake Bay	Larry Schwartz Evaluation of Environmental Benefits for the Louisiana Coastal Area (LCA) Small Diversion at Convent/Blind River Project	Daniel Baker Incorporating Decision Analysis and Predictive Design into Stream Restoration: The Stream Project	Wes Burger Ecosystem Restoration Efforts on Private Lands: The Role of Farm-scale Planning and Delivery	Panel Discussion on Desired Characteristics of Aquatic Habitat Restoration and Preservation Prioritization Decision Support	Chris Cotroneo Harvesting Macroalgae as a Means of Reducing Nutrients in Jamaica Bay, New York City	David Bauman Managing Invasive Plant Species in the Picayune Strand Restoration Project, Southwest Florida
3:00	PM Break							

TUES 8/2		TUESDAY, AUGUST 2, 2011 (continued)						
3:30-5:00	<p align="center">Restoration Coffee House Plenary Session on Chesapeake Bay (Harborside Ballroom – Level 4)</p> <p align="center">Moderator: Tim Wheeler, Reporter, The Baltimore Sun</p> <p align="center">Coffee House Panelists: Jeff Corbin, Special Assistant to EPA Administrator—Chesapeake Bay Program Will Baker, President, Chesapeake Bay Foundation Ann Pesiri Swanson, Executive Director, Chesapeake Bay Commission Robert Summers, Secretary of the Environment, Maryland Department of the Environment</p>							
5:00 - 6:00	<p align="center">Plenary “Listening Session” with State & Federal Agency Representatives (This session will elicit feedback from stake-holders, cooperators and agency representatives as part of a “restructuring” of USGS mission areas by the Ecosystem Science Strategy Planning Team.)</p>							
6:00-8:00	<p align="center">Poster Session I and Networking Reception in the Exhibit Hall (Grand Ballroom - 3rd Floor)</p>							
WED 8/3		WEDNESDAY, AUGUST 3, 2011						
7:00-1:00	<p align="center">Conference Registration Open</p>							
7:00-8:00	<p align="center">Morning Refreshments in Exhibit Hall (Grand Ballroom - 3rd Floor)</p>							
8:00-9:30	<p align="center">CONCURRENT SESSIONS</p>							
	Ecosystems of National Significance	Chesapeake Bay Oyster Restoration Under the Executive Order	Natural Resource Damage Assessment and Restoration Session 1	Louisiana Coastal Restoration & the Louisiana Coastal Area (LCA) Projects	Building with Nature: Combining Ecological and Economic Interests	The Baltimore Watershed Agreement: An Interjurisdictional Approach to Watershed Restoration	Managing the Science of Everglades Restoration	Water Quality Nutrients, Contaminants and Sustainable Sediment Management
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	Roselle Henn	Bruce Vogt	Michael Hooper	Mark Wingate	Barry Dubinski	Nicole Stern	Gretchen Ehlinger	Wendy Sotera
8:00-8:10	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
8:10-8:30	James Edward Vision for Protecting and Restoring the Chesapeake Bay Watershed Restoration and Measuring Success	Bruce Vogt Collaborative Approach to Bay Oyster Restoration	Steve Glomb Overview of Natural Resource Damage Assessment and Restoration	Darrel Broussard Coastal Restoration and Louisiana Coastal Area (LCA) Overview, US Army Corps of Engineers	Huib de Vriend Building with Nature: Nature Beyond Restoration	Nicole Stern An Introduction to the Baltimore Watershed Agreement Action Plan	Dave Tipple Interagency Scientific Oversight of Everglades Restoration: RECOVER Ten Years Later	Zhonglong Zhang Development of SWAT Models to Quantify Sediment and Nutrient Losses from Missouri and Upper Mississippi River Basins
8:30-8:50	Kelly Baxter-Osborne Puget Sound Nearshore Ecosystem Restoration Project: Defining Restoration Vision and Measuring Success	Angela Sowers Chesapeake Bay Oyster Restoration: The USACE Perspective – Past, Present, and Future	Kristin Skrabis The Role of Economics in the Natural Resource Damage Assessment and Restoration Process	Bren Haase Louisiana Coastal Restoration and LCA Overview, State of Louisiana’s Perspective	Karin Krchnak Effective Partnering to Advance Integrated River Basin Management	Steven Stewart The Baltimore Watershed Agreement: Challenges & Successes of Collaborative County, City, & NGO Monitoring Efforts	Fred Sklar A Conceptual Ecological Model for Everglades Tree Islands	John Brakebill Supporting Chesapeake Bay Restoration by Modeling Nutrient and Sediment Sources and Transport
8:50-9:10	Peter Weppler Restoration Planning for the Hudson-Raritan Estuary – An Example of Collaboration	Eric Weissberger Maryland’s Role in Chesapeake Bay Oyster Restoration	Janet Whitlock The Nexus Criterion: Linking Resource Injuries to Restoration Projects	Natalie Snider Disconnect Between Restoration Planning and Restoration Needs: Advocating a Different Timeline	Kevin Brennan and Mark Mendelsohn Remote Island Restoration in the Chesapeake Bay Through the Beneficial Use of Dredged Material	Duncan Stuart Baltimore Watershed Agreement (BWA): Challenges & Successes of Collaborative Planning	Susan Kemp Setting Salinity Targets for Restoration in South Florida’s Estuaries	William Orem Sulfate as a Contaminant in Freshwater Ecosystems – Sources, Impacts and Mitigation
9:10-9:30	Susan Rees Gulf Coast Restoration Mississippi Style: Achieving the Philosophy of the Gulf of Mexico Alliance Through Mississippi Coastal Improvement Program	Howard Townsend The Oyster Data Tool: Compiling State and Federal Oyster-related Data into a Single Database	Molly Sperduto Benefits of Monitoring Common Loon Restoration Following the North Cape Oil Spill	Barbara Kleiss Promoting Science-based Decisions: The Louisiana Coastal Area (LCA) Science and Technology (S&T) Program	Alex Brunton Analysis of Flooding and Sediment Transport by Numerical Modeling as Part of the Don River Mouth Naturalization Project, Toronto	Nancy Pentz BWA: Challenges and Successes of Collaborative County, City, and NGO Public Outreach and Awareness Efforts	Agnes McLean Adaptive Management in Everglades Restoration: Decentralization of Water Conservation Area 3	Nicholas Albergo Latex Recovery and Process Water Treatment, Liberia, West Africa
9:30-10:00	<p align="center">AM Break in the Exhibit Hall (Grand Ballroom - 3rd Floor)</p>							

Fourth National Conference on Ecosystem Restoration (NCER)

WED 8/3	WEDNESDAY, AUGUST 3, 2011 (continued)							
10:00-11:30	CONCURRENT SESSIONS							
	Facilitating Environmental Restoration through the Application of Ecosystem Services	Local, District and State Government Contributions to Chesapeake Bay Ecosystem Restoration	Natural Resource Damage Assessment and Restoration Session 2	Louisiana Coastal Restoration	Overcoming Institutional Barriers for Effective Implementation of Adaptive Management	Ecosystem Restoration Program Management and Large-scale Project Management I	Ecosystem Restoration and Large-scale Project Implementation: The Ohio River Basin	Use of Remote Sensing and Mapping in Ecosystem Restoration
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	David Moore	Andrea Ryon	Susan Kennedy	Rob Daoust	Tom St Clair	Eric Hughes	Beth Cade	Joanne Chamberlain
10:00-10:10	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
10:10-10:30	Lisa Wainger Measuring Economic Benefits of Restoration for Spatial Targeting and Ecosystem Service Trades or Offsets	Pete Hill Stormwater Management and Habitat Restoration for the Benefit of the District of Columbia and the Bay	Jennifer Hill-Kelley Assessment and Restoration of Tribal Cultural Resources	Yvonne Allen Using Systemwide Assessments of Habitat Condition in the Atchafalaya Basin to Identify and Evaluate Management Improvements	Kenneth Barr Towards Effective Adaptive Management on the Upper Mississippi River System	Megan Roessing An Overview of the Collaborative Forest Landscape Restoration Program	Beth Cade Watershed Planning for Restoring Sustainable Ecosystems in the Ohio River Basin	Raul Mercado HyperSpectral / LIDAR/RADAR Imagery for Water Quality Monitoring and Environmental Assessment in Ecosystem Restoration
10:30-10:50	Wayne Munns Improving Hazardous Waste Site Remediation and Restoration Decisions Using Ecosystem Services	Ken Pensyl Maryland Stormwater Act and Watershed Implementation Plans	Michael Hooper Confronting Climate Change Through Restoration – Department of the Interior NRDAR Program	Melissa Kenney Integrating Delta Building Physics & Economics: Optimizing Engineered Avulsions in the Mississippi Delta	Craig Fleming Organizational Restructuring has Facilitated Implementation of AM for MRRP	Betty Dehoney Bay Delta Conservation Plan	Rob Simmonds The Ohio River Basin Fish Habitat Partnership and Aquatic Ecosystem Restoration	Lawrence Spencer Responses of Floodplain Wetland Vegetation to Kissimmee River Restoration Project Phase I
10:50-11:10	Matthew Wartian Role of Ecosystem Services in Habitat Equivalency Analysis	Uwe Kirste Watershed Management Planning in Prince William County, VA	Bruce Bayne A Company Perspective on Cooperative Assessment and Restoration: A Case Example from a CERCLA Site	Jason Farmer Ecosystem Planning at Warp Speed: The LCA Medium Diversion at White Ditch Story	Andy LoSchiavo Everglades Restoration AM Program: Challenges and Solutions	David Galat Great Rivers that Work for People and Nature	John Stark The Nature Conservancy's Ecosystem Strategies and Objectives for the Ohio River Basin	Holly Beck Accessing Biophysical Signatures in Remote Sensing Data to Inform Eco-hydromorphic Characterization of the Louisiana Coastal Landscape
11:10-11:30	Steve Gruber Role of Ecosystem Services in Watershed Management	Jeff Perry Planning for Chesapeake Bay TMDL Implementation in Henrico County, VA	John Schmerfeld Restoration Options for Neotropical Birds: A Look Toward the Future	Lawrence Haase & Lucila Silva Louisiana Coastal Restoration and Protection Planning Strategies: Projects to Implementation	Jennifer Pratt Miles Designing Collaborative Approaches for Effective Adaptive Management	Christopher McVoy The River of Grass Paradigm: Everglades Restoration Planning Through Model-Assisted, Interactive Public Engagement	Richard "Gus" Drum Using Section 729 Watershed Assessments for Ecosystem Restoration in the Ohio River Basin	Amanda Oliver Bathymetric Data and Aerial Photography Provide Insight into Five Decades of Lower Mississippi River Side Channel Change
10:30-11:30	Board Buses for Optional Field Trips (Some trips to distant locations must depart earlier. Consult the program book for a detailed boarding schedule for each trip. Feel free to check with the registration staff to see if there are vacancies.)							
11:30-7:00	Afternoon on Own for Field Trips, Ad Hoc Meetings or Networking							
THURS 8/4	THURSDAY, AUGUST 4, 2011							
7:30-5:30	Conference Registration Open							
7:30-8:30	Morning Refreshments in the Exhibit Hall (Grand Ballroom - 3rd Floor)							
8:30-10:00	Plenary Session – Linking Land and Ocean (Harborside Ballroom - 4th Floor) Moderator: Suzette Kimball , Deputy Director, US Geological Survey Plenary Speakers: Larry Robinson , Assistant Secretary for Commerce for Oceans and Atmosphere, NOAA Kameran Onley , Director of US Marine Policy, The Nature Conservancy Dave White , Chief, USDA Natural Resources Conservation Service (NRCS)							
10:00-10:30	AM Break in the Exhibit Hall (Grand Ballroom - 3rd Floor)							

THURS 8/4		THURSDAY, AUGUST 4, 2011 (continued)						
CONCURRENT SESSIONS								
	Implementation and Political Challenges to Ecosystem Restoration	Assessing Ecosystem Service Benefits of Ecosystem Restoration and Management	Planning and Design for Climate Change Impacts: Ebb and Flood	Implementing Restoration: Progress in the Light of Process	Ecosystem Restoration Program Management and Large-scale Project Implementation	Real Estate Challenges Within Large-scale Ecosystem Restoration Programs	Resilience of Integrated Coastal Systems	Instream and Freshwater Inflow Development
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	Scott Slocum	Dennis King	Karen Appell	Casey Kruse	Brian Files	Chuck Padera	S. Kyle McKay	Laura Stroup
10:30-10:40	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
10:40-11:00	Eliza Cava Evolution of an Idea and an Institution: Assessing Army Corps of Engineers Progress in Large-scale Ecosystem Restoration in the Florida Everglades	Todd Gartner Using Incentives to Connect Forests, Water, and Communities in the Northeast United States	This session features presentations by multi-disciplinary experts followed by Q&A. PANELISTS: Art Miller Christine May Helen K.C. McMillan Bethany Bearmore Robert Esenwein Peter Weppeler Peter Wijsman	Mary Roth Challenges of Stakeholder Engagement in the Missouri River Recovery Program	Storm Cunningham Designing, Funding, Implementing and Managing Large-scale, Long-term Ecosystem, Watershed and/or Fishery Restoration Programs	Sharon Conklin Relocating a Way of Life	Kyle McKay Assessing Resilience of Coastal Ecosystems	Denise Reed How Much Flow is Enough? Contrasting the Role of Riverine Inputs in Estuarine Ecosystem Restoration in California Bay-Delta and the Mississippi Delta
11:00-11:20	Eric Bush Managing Implementation of an Ecosystem Restoration Program	Leslie Richardson Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats	<ul style="list-style-type: none"> Planning for the Impact of Climate Change for FEMA's National Flood Insurance Program Adapting to Rising Tides: San Francisco Bay Area Climate Change, Vulnerability, and Risk Assessment 	Gretchen Ehlinger Working with FACA – Challenges to Large-scale Ecosystem Restoration Programs	Kevin O'Donnell Integration of Existing EPA Authorities and New Restoration Efforts to Accelerate Recovery of Areas of Concern in the Great Lakes Basin	Willie Patterson Real Estate Acquisition: Post Hurricane Katrina	Bhaskaran Subramanian Enhancing Coastal Resilience with Integrated Planning by the State of Maryland	Danielle Kreeger Importance of Freshwater Inflow for Natural Resources of the Lower Delaware River Basin and Estuary
11:20-11:40	Jed Redwine Where Should We Act and at What Scale? Defining the Meaning of Restoration from an Ecological Perspective	Katherine von Stackelberg A Systematic Review of Ecosystem Services from Green Space	<ul style="list-style-type: none"> Addressing Sea Level Rise Impacts on Tidal Wetland Restoration Projects: Development of NOAA Design Guidance and Potential Applications 	Kim Dryden Picayune Strand Restoration Project in Southwest Florida: A Landscape Perspective and Interagency Effort	Dan Miller & Marvin Hubbell Environmental Restoration on the Upper Mississippi River System: The USACE/Contractor Relationship	Matt Krajewski Federal Mandates and Willing Sellers: Real Estate Acquisition for the Missouri River Recovery Program	Leslie Suazo Resilience in Coastal Louisiana	Shae Luther The Importance of Reuse Water in Instream and Freshwater Inflows: The Case of Texas
11:40-12:00	Jim Henderson Ecosystem Services and the Corps of Engineers: Now that We've Identified Them, We're Figuring Out What to Do	Kathy Anderson Environmental Benefits of an Urban Stream Restoration		Greg Miller Effective Public Involvement Strategies for Restoration Planning	Orlando Ramos-Gines Maximizing Learning and Successes of Fast-Paced Large-scale Projects While Adapting Bureaucratic Processes and Practices	Bruce Sackett Platte River Recovery Implementation Program: Real Estate Methods of a Willing Buyer Willing Seller Acquisition Program	Craig Fischenich A Framework for Adaptively Managing Restoration Projects in Coastal Louisiana	Paul Conrads Analyzing the Effects of the Hydroelectric Plant Releases on the Hydrology of the Congaree National Park Floodplain, South Carolina

THURS 8/4	THURSDAY, AUGUST 4, 2011 (continued)							
12:00-1:30	LUNCH ON OWN							
1:30-3:00	CONCURRENT SESSIONS							
	Making Adaptive Management Meaningful – Bridging the Science / Decision-Making Gap	Addressing Water Resources Challenges in the Sacramento – San Joaquin Bay-Delta	Restoration Efforts on Private Lands	Legal Issues in Ecosystem Restoration	Stakeholder Engagement and Perspectives	Integrating Long-term Proxy Records of Sea-level Rise and Climate Change into Planning	Foundations for Large River Restoration Planning	Dam Removal: The Goldilocks Approach
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	Chad Smith	Cindy Tejeda	Erik Meyers	Phil Steffen	Beverly Getzen	Debra Willard	Robert Pace	Serena McClain
1:30-1:40	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
1:40-2:00	Ernest Clarke Bridging the Science / Decision-Making Gap in the Trinity River Restoration Program	Chip Smith Proactive Solutions for America's Water Resources Needs: Planning for Tomorrow's Challenges	Katherine Basiotis Protecting the Chesapeake Bay: Voluntary Projects on Private Lands	Mark Shafer Ecosystem Restoration on Former Agricultural Lands: The CERP and Evolving Corps HTRW Policy	Susan Testroet-Bergeron Exercising Various Techniques to Engage the Public in Louisiana's Coastal Restoration	Laura Brandt Reconstructing Vegetation Response to Altered Hydrology and its Use for Restoration — Arthur R. Marshall Loxahatchee National Wildlife Refuge	Robert Jacobson Conceptualizing and Communicating Ecological River Restoration	Jennifer Bountry Guidelines for Assessing Sediment-related Effects of Dam Removal
2:00-2:20	Dennis Kubly The Intersection of Science and Decision Making in the Glen Canyon Dam Adaptive Management Program	Paul Robershotte A Systems Framework for the Bay-Delta: A Regional Perspective	Frank Casey Implementing Landscape Conservation Cooperatives: Science and Policy Implications of Payments for Ecosystem Services Programs	Herman Jarboe Legislative Drafting Service Fundamentals for Ecosystem Restoration Projects	Karla Sparks Innovative Methods for Incorporating Tribal Natural Resource Information into the Missouri River Ecosystem Restoration Plan	Ellen Thomas Long Island Sound: Relative Sea Level Rise over the Last Millennium	John Nestler The River Machine: A Conceptual Model for Large Rivers Integrating Fish Movement and Habitat, Fluvial Geomorphology, Fluid Dynamics and Biogeochemical Cycling	Adam Pearson Geomorphic Response of the Souhegan River to the Removal of the Merrimack Village Dam
2:20-2:40	Kent Loftin The Science-Decision Making Interface of the Kissimmee River Restoration Program	Brooke Schlenker and Ed DeMesa Integrated Flood Risk Management and Ecosystem Restoration on McCormack-Williamson Tract	Anthony St. Aubin Skokie River Woods Wetland Restoration and Enhancement Project	Cheryl Ulrich Endangered Species Act's Implementation Challenges to Large-scale Ecosystem Restoration Programs	Kelly Brennan The Importance of Stakeholder Involvement in Small Watershed Action Plans & Maintaining Stream Health	Lynn Wingard Potential Impacts of Climate Change and Sea Level Rise on South Florida's Coastal Wetlands	Kelly Burks-Copes Ecosystem Modeling for the Missouri River Cottonwood Management Plan	Mary Andrews Designing and Implementing Dam Removal Projects in the Context of the Regulatory Climate: The Simkins Dam Removal Case Study
2:40-3:00	David Marmorek What Determines Whether or Not Adaptive Management Programs Affect Management and Policy Decisions?	Paul Marshal Integrated Sustainable Water Management for California: Addressing Current Physical and Institutional Challenges to Meeting Future Needs	Jeffrey Lee Valley Creek Watershed and Stream Restoration	Richard Grosso My Perspective on Top Legal Issues in Ecosystem Restoration (<i>invited</i>)	Cynthia Wood The NRCS/USACE Partnership Handbook: A Field Guide to Working Together Toward Shared Goals	Christopher Bernhardt Marl Prairie Vegetation Response to 20th Century Land Use and its Implications for Management in the Everglades	John Nestler Reference Condition Approach to Large River Restoration Planning	Mathias Collins Improving Implementation and Effectiveness Monitoring at Dam Removal Sites and their Integration with Project and Program Planning
3:00	PM Break in Exhibit Hall (Grand Ballroom - 3rd Floor)							
3:30	Restoration Coffee House Plenary Session on Communication in Ecosystem Restoration							
	Moderator: Terence Smith, PBS Award Winning Journalist							
	Coffee House Panelists: Tom Horton, Author Chris Mooney, Freelance Writer David Farenthold, The Washington Post Christopher Joyce, National Public Radio							
5:30-7:30	Poster Session II and Networking Reception in the Exhibit Hall (Grand Ballroom - 3rd Floor)							

FRI 8/5	Friday, August 5, 2011							
7:30-1:00	Conference Registration Open							
7:30-8:30	Morning Refreshments in the Exhibit Hall (Grand Ballroom - 3rd Floor)							
8:30-10:00	CONCURRENT SESSIONS							
	Climate Change and Restoration	Pieces of the Puzzle: Restoring the Chesapeake Bay Ecosystem	Management Aspects of Large-scale Ecosystem Restoration	Environmental Benefit Justification on Ecosystem Restoration Projects	Great Lakes Restoration Initiatives and Approaches	Aquatic Habitat Restoration and Adaptive Management in Southwest U.S.	Estuarine Ecosystems Restoration	Dam Removal
	Harborside A & B 4th Floor	Harborside D & E 4th Floor	ESSEX 4th Floor	Laurel 4th Floor	Kent 4th Floor	Dover 3rd Floor	Waterside A Lobby Level	Waterside B Lobby Level
Moderator	Glenn Landers	Rich Batiuk	Peyton Robertson	Susan Conner	Joe Pfeiffer	N. Kennedy & L. Skaggs	Scott Phillips	Heather Day
8:30-8:40	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview	Introduction & Overview
8:40-9:00	Matthew Goldman Mitigation, Adaptation, Resilience: The Evolving Role of Climate Change in Restoration	John Shuman A History of Agricultural BMPs in the Octoraro Creek Watershed and Associated Nutrient Load Reductions to Chesapeake Bay	Todd Hopkins Landscape Conservation Cooperatives: Working Together to Sustain America's Land, Water, Wildlife and Cultural Resources	Brad Foster Tamiami Trail: Comparison of Ecological Benefit Methods Used by Different Federal Agencies	Mike Greer US Army Corps of Engineers Role in the Great Lakes Ecosystem Restoration Initiative	Ondrea Hummel Evaluating Restoration Success and Applying Adaptive Management in the Middle Rio Grande Bosque	Laura Lee Wilkinson & Lee Walker Planning Hurricane Storm Damage Risk Reduction: Minimizing Impacts to Lake Pontchartrain	David Huntress "Natural" Riverine Recovery Following Dam Removal
9:00-9:20	Cindy Barger Thinking Ahead: Incorporating Climate Change into Aquatic Ecosystem Restoration Planning for the Ala Wai Watershed Project	Rebecca Golden Maryland's Large-scale Eelgrass (<i>Zostera marina</i>) Restoration: A Retrospective Analysis of Techniques, Costs and Monitoring	Sarah Miller Defining the Spatial and Temporal Extent of Ecosystem Restoration Project Environmental Benefits	Richard Cole A Case Study Comparison of Two Indices for Ranking Ecosystem Restoration Projects Based on National Benefit	Burton Suedel Concept and Approaches for Adding Environmental Enhancements to Great Lakes Breakwaters and Jetties	Daniel Artho Ecosystem Restoration on the Truckee River, Nevada: Integrating Ecosystem Restoration with Flood Risk Management in High-desert Landscape	David Gorman Wapato Access Feasibility Study: Restoring Columbia River Salmonid Rearing Habitat	Shane Cline Gold Ray Dam Removal – Removal of the Last Fish Barrier on the Lower Rogue River
9:20-9:40	Randy Davis Wildland Forest Soil Carbon Management	Sharon Madden Environmental Management at DoD Facilities in the Chesapeake Bay Region	Brian Mastin Bioremediation's Integral Role in Ecosystem Restoration and Rehabilitation	Joe Berlin Estimating Recreational Benefits from Coastal Restoration Projects in Louisiana	Don Schloesser Restoration of Burrowing Mayflies (<i>Hexagenia spp.</i>) in the Laurentian Great Lakes	Thomas Keeney Endangered Species Ecosystem: Striking a Balance Using Flood Risk Management	Frank Marshall Setting Restoration Targets in Florida Bay Using Paleocology and Salinity/Hydrology Models	Mark Riedel Marion Mill Pond Dam Removal and Stream Restoration for Great Lakes Fisheries Restoration
9:40-10:00	Fred Bloetscher Fighting Water with Water: Counteracting the Impact of Sea Level Rise on South Florida Waters	Greg Noe The Effects of Riparian Ecosystem Processes on Water Quality: Nutrient Mineralization and Budgeting	Jeff Couch Central and Southern Florida: West Palm Beach Canal (C51) STA 1-East Improvements	Dennis Duke Challenges in Benefit Analysis and Project Justification	Gail Krantzberg Great Lakes, Great Stakes	William Brostoff Estuarine Restoration in San Francisco Bay: Design and Adaptive Management	Kat Morgan Fish and Floods – Where Trackhoes Hit the Mud in Puget Sound's Stillaguamish Estuary	Jock Conyngham Rethinking Instream Structures
10:00-10:20	Steve Traxler Addressing the Challenge of Climate Change in the Greater Everglades Landscape	Kennedy Paynter Oyster Restoration in Maryland	Jeremy Crossland USACE Moves Toward Improved Invasive Species Management Activities	Jeffrey Tripe Integrating Conservation Planning Methods, Conceptual Models, USACE Planning Requirements and NEPA	Kevin Guerin Canadian Partnerships and Programs for Great Lakes Restoration	Brian Mulvey Forecasting Fish Response to Habitat Features in Developing Riparian Project Design Alternatives	Chris Cotroneo Working Towards Nutrient Reduction in Eutrophic Urban Estuary: Ribbed Mussel Biofiltration in Jamaica Bay	Elvidio Diniz Dam Removal Impacts – Planning Considerations
10:20-10:30	AM Break and Session II Poster Removal (Exhibit Hall - 3rd Floor)							
10:30-12:00	<p>Closing Plenary Session – Restoration After the Deepwater Horizon Oil Spill (Harborside Ballroom A & B – 4th Floor)</p> <p>Moderator: Suzette Kimball, Deputy Director, US Geological Survey</p> <p>Plenary Speakers:</p> <p>Lisa Jackson, Administrator, US Environmental Protection Agency (EPA)</p> <p>Garret Graves, Chair, Coastal Protection and Restoration Authority of Louisiana (CPRA)</p> <p>Don Boesch, President, University of Maryland Center for Environmental Science (UMCES)</p>							
12:00	CONFERENCE CONCLUDES							
10:30-2:00	Exhibitors & Session II Posters Move Out (All displays must be removed by 2:00)							

Poster Directory & Poster Display Specifications

Poster Session I:

- **POSTER SET UP:** Monday, August 1, 7:30am-12:00pm
- **POSTER SESSION RECEPTION:** Tuesday, August 2, 6:00pm-8:00pm
Presenters should be stationed at their posters for discussion with attendees from 7:00pm- 8:00pm during the reception.
- **POSTER REMOVAL:** Wednesday, August 3, (Session I poster displays to be removed by 11:00am.)

Poster Session II:

- **POSTER SET UP:** Thursday, August 4, 7:30am-8:30am
- **POSTER SESSION RECEPTION:** Thursday, August 4, 5:30pm-7:30pm
Presenters should be stationed at their posters for discussion with attendees from 6:30pm- 7:30pm during the reception.
- **POSTER REMOVAL:** Friday, August 5, 10:30am-12:00pm (Please note: Poster display boards will be dismantled and removed by the vendor at 12:00pm on Friday, so please have your poster down by this time. If not, the conference organizers are not responsible for lost or damaged posters removed by the display board vendor. Posters not removed and left behind will be discarded.)

Poster Session I

Poster #	First Name	Last Name	Organization	ST	Abstract Title
69	Kathryn S.	Barnicle	AECOM Environment	MA	Balancing Urban Growth and Sustaining Valued Eelgrass Habitat: Monitoring to Meet Future Restoration Goals on Cape Cod, MA
75	Getulio	Batista	University of Taubaté		<i>Jatropha curcas</i> L. for Degraded Lands' Restoration and Greenhouse Gases' Emission Mitigation
76	Getulio	Batista	University of Taubaté		Remote Sensing Tools for Restoration: A Case Study of a Median Size Hydrographic Basin in Brazil
41	Doug	Bauer	Pizzo & Associates, LTD	IL	Successful Specification Development and Execution: Redefining the Aesthetic Appeal of Landscape Scale Restoration Efforts
31	Gretchen	Benjamin	The Nature Conservancy	WI	Integrated River Basin Management on the Mississippi River
81	David	Blersch	State University of New York at Buffalo	NY	A Case Study in Interdisciplinary Collaborative Education in Ecosystem Restoration: The ERIE Practicum at the University at Buffalo
61	Paul	Boyd	U.S. Army Corps of Engineers	NE	Evaluation of Hydraulic Flushing for Sediment Management at Lewis and Clark Lake: Assessing Effectiveness and Impacts using GSTARS4
21	John	Brock	U.S. Geological Survey National Wetlands Research Center	VA	Coastal Societal Vulnerability Index for the Northern Gulf of Mexico
62	Chris	Budai	USACE, Portland District	OR	Monitoring/Evaluation Planning for Environmental Flows on the Middle Fork of the Willamette River, OR - A Sustainable Rivers Project (SRP)
63	Chris	Budai	USACE, Portland District	OR	Environmental Flows and the Sustainable Rivers Project
7	Kate	Buenau	Pacific Northwest National Laboratory	WA	Valuing Information With Predictive Models in the Missouri River Recovery Program
8	Russell	Burke	Christopher Newport University	VA	Alternative Substrates as a Native Oyster Reef Restoration Strategy in Chesapeake Bay
70	Tom	Chapman	Milw Meto Sewerage District	WI	Underwood Creek Rehabilitation and Flood Management, Wauwatosa, WI
43	Jock	Conyngham	Army Engineer Research and Development Center	MT	Threshold Concepts in Ecosystem Restoration Benefits Assessment
25	Jeremy	Crossland	US Army Corps of Engineers	FL	Successful Invasive Species Management Activities in 8.5 SMA, A Modified Waters Delivery Restoration Project
71	David	Robbins	U.S. Army Corps of Engineers	MD	Restoring the Anacostia River Watershed

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64	Chris	D'Arcangelis	Stanley Consultants	AZ	Ecosystem Restoration of the Salt River, Va Shly 'ay Akimel
22	Ed	Demesa	US Army Corps of Engineers	CA	USACE Role in Creative Solutions to Water Shortages in Southern California: Connecting the Dots of Water Conservation, Environmental Infrastructure, and Local Groundwater Resources
3	Judi	Durda	Integral Consulting	MD	Use of Decision Frameworks in Natural Resource Damage Assessments to Expedite and Promote Ecosystem Restoration
52	Gretchen	Ehlinger	US Army Corps of Engineers	FL	Development of a Technically-based, Objective and Strategic Monitoring Strategy to Guide Restoration in the South Florida Ecosystem
9	Kris	Esterson	EPJV	FL	Considerations for Ecosystem Restoration Adaptive Management Programs in Addressing Climate Change
44	Bradley	Foster	U.S. Army Corps of Engineers	FL	Accelerating Ecosystem Benefits in Picayune Strand Using Advanced Construction
53	Dana	Gentry	U.S. Army Corps of Engineers-Jacksonville District	FL	Decomartmentalization and Sheetflow Enhancement within Water Conservation Area 3: Challenges in Planning for Large-Scale Ecosystem Restoration Projects
26	Donald	Hagan	University of Florida	FL	Understory Recovery Following Cogongrass Eradication in a Longleaf Pine Sandhill Community
5	Brooke	Hall	United States Army Corps of Engineers	FL	10 Billion dollars of Ecosystem Restoration at a Glance: Lessons learned from the Everglades Integrated Delivery Schedule
32	Matt	Harwell	U.S. Fish and Wildlife Service	FL	Communicating System-wide Science to a Spectrum of Audiences: Utilizing an Interactive Web-page to Publish the CERP System Status Report
28	Jim	Henderson	US Army Corps of Engineers	MS	Using Environmental Expenditures to Inform Restoration Planning
29	Jim	Henderson	US Army Corps of Engineers	MS	Invasive Species and the Corps of Engineers: What are the Costs?
42	Heather	Henkel	U.S. Geological Survey	FL	The South Florida Information Access (SOFIA) System and Everglades Depth Estimation Network (EDEN): Providing Support for Everglades Restoration
45	John	Hickey	US Army Corps of Engineers	CA	HEC Software Tools for Ecosystem Restoration and Management
34	Eliza	Hines	Everglades Partners Joint Venture/PBS&J	FL	Communicating System-wide Scientific Findings: Lessons Learned from Development of the RECOVER System Status Report
35	Eliza	Hines	Atkins	FL	Integration of Key Scientific Findings for Everglades Restoration in an Interagency Report

33	Althea	Hotaling	University of Florida	FL	Policy and Permitting Recommendations to Promote and Increase the Effectiveness of Submerged Habitat Restoration Efforts in Southwest Florida
36	Marvin	Hubbell	US Army Corps of Engineers	IL	Nationally Significant Ecosystems – Related Efforts in the Upper Mississippi River System (UMRS)
72	Lisa	Huntington	Environmental Consulting & Technology	MI	Post-Construction Analysis of Sediment Transport in Millers Creek
54	Dave	Johnson	HDR Engineering, Inc.	MO	The Red River of the North: Habitat Restoration in a Broad Floodplain
55	Wendy	Katagi	CDM, Inc.	CA	Roadmap to Large-Scale Ecosystem Restoration in the Arroyo Seco Watershed
37	Susan	Kemp	US Army Corps of Engineers, Jacksonville District	FL	Taylor Slough – An example that operations and flow can effect changes in the Everglades and Florida Bay
38	Dennis	Krohn	USGS	FL	Re-Creation of Ecotone Transitions in South Florida from Theoretical Model Distributions and Sea-Level Rise Curves
73	Jeffrey	Lee	Barr Engineering Company	MN	Nine Mile Creek - Urban Watershed and Stream Restoration Planning and Implementation
10	Jamie	Lefkowitz	CDM	MA	Management Options for Phosphorus Load Reduction to the Assabet River Amid Regulatory and Stakeholder Challenges
46	Justin	Lennon	Parsons Brinckerhoff	MD	Connecting Water Quality to Infrastructure Protection: A Case Study of Urban Stream Stabilization
13	Igor	Linkov	US Army Corps of Engineers	MA	Adaptive Management and Ecosystem Modeling: Approach and Application to Everglades
56	Dawn	LoBaugh	HDR Engineering, Inc.	CA	Sacramento-San Joaquin Delta Habitat Conservation–Meeting the Ecological Needs of an At-Risk System, Phase I
11	Andrew	LoSchiavo	USACE	FL	Tools to Reduce Uncertainty in the USACE Project Implementation Process
12	Andrew	LoSchiavo	USACE	FL	BISCAYNE BAY COASTAL WETLANDS PROJECT ADAPTIVE MANAGEMENT PLAN
14	Christopher	Mader	University of Miami	FL	ICEM-CTK: An OWL ontology for building Conceptual Ecological Models
65	Matthew	Mallard	USACE, MVD, Vicksburg District	MS	Amite River and Tributaries Ecosystem Restoration
66	Mickey	Marcus	New England Environmental, Inc.	MA	The Successful use of Large Woody Debris for Bank Stabilization on the Connecticut River
4	Amanda	Maxemchuk	Battelle	MA	Results of the Independent, External Quality Assurance Review of Models Used for Ecosystem Restoration Project Planning and Management

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74	Kaitlin	McCormick	EA Engineering, Science, and Technology	MD	Environmental Compliance and Development of a Compensatory Mitigation Package for the Masonville Dredged Material Containment Facility Project
47	Max	Millstein	U.S. Army Corps of Engineers	FL	Reduction of Cattail Expansion in the Everglades: A Performance Measure Application
15	Alaina	Owens	Brown and Caldwell	LA	An Adaptive Management Framework for Implementing the 2012 Update of Louisiana's Comprehensive Master Plan for a Sustainable Coast
77	JORGE	PALADINO DE LIMA	FEDERAL RURAL UNIVERSITY OF RIO DE JANEIRO, BRAZIL		BIOMASS ESTIMATION FOR CARBON CYCLE OF BRAZIL BIOMES
78	JORGE	PALADINO DE LIMA	UFRRJ		NATURAL VULNERABILITY OF AN AQUIFER SYSTEM IN BRAZIL
16	Douglas	Partridge	ARCADIS, U.S., Inc.	NJ	Restoration of a Tidal Salt Marsh along the Raritan River Using Intensive Adaptive Management
23	Joseph J.	Pfeiffer, Jr	KCI Technologies Inc	NC	Ecosystem Restoration with Gorilla Tactics: Restoration of Grand Lake St. Marys Ecosystem through Economic Development
48	Bruce	Pruitt	U.S. Army Corps of Engineers	MS	The Application of Reference Condition and Concepts to Assessing Restoration Benefits
39	Gina	Ralph	U.S. Army Corps of Engineers	FL	Everglades Restoration Transition Plan: A Multi-Species Approach to Water Management within South Florida.
2	Charles	Rewa	USDA NRCS	MD	The USDA Conservation Effects Assessment Project (CEAP) Wildlife Component
24	Valerie	Ringold	US Army Corps of Engineers	OR	A Gateway to Building a Strong Community of Practice for Ecosystem Restoration
79	Andrew	Roach	U.S. Army Corps of Engineers, Baltimore District	MD	Modeling Project Alternatives for the Anacostia Restoration Plan
17	Emily	Rodriguez	University of Florida	FL	Maximizing Wiregrass (<i>Aristida Stricta</i>) Reproduction for Restoration Purposes: Effect of Growing Season Month of Burn on Seed Production
80	John	Roebig	HDR	NY	Adaptive Design of a Salt Marsh during Construction in a highly Urbanized Environment of New York City: The Alley Park Restoration Project
40	Joana	Savinon	US Army Corps of Engineers	FL	The Loxahatchee River Watershed Restoration Project: Restoring Wild and Scenic Florida
67	Michael	Schwar	HNTB Corporation	WI	Implementing Riparian Ecosystem Restoration Using a Design-Build Framework: Tres Rios Ecosystem Restoration Project Phase 3, Phoenix AZ

58	Priya	Shahani	Monarch Joint Venture	MN	The Monarch Joint Venture: Building a National Restoration Program to Protect the Monarch Migration and Pollinator Habitats
18	Ajay	Sharma	University of Florida	FL	Restoration of Longleaf Pine - Slash Pine Ecosystems in Flatwood Habitats of Florida: Effect of Management Systems and Species Composition on Understory Light Availability
68	Jerry	Skalak	U.S. Army Corps of Engineers	IL	Implementation of a Non-structural Alternative to Levee Repair Under the Corps of Engineers' P.L. 84-99 Authority: The Green Island, Iowa, Levee and Drainage District
19	Anthony	St. Aubin	JFNew	IL	Restoration Conversion of Boreal Forest Wetlands in Superior, Wisconsin
20	Anthony	St. Aubin	JFNew	IL	Indiana Toll Road Mitigation, Urban Restoration in Gary, Indiana
51	David	Stites	Taylor Engineering, Inc.	FL	Calculating Net Benefits of Ecosystem Restoration in Coastal Texas
50	Burton	Suedel	US Army Corps of Engineers	MS	Environmental Restoration as a Decision-Analytical Problem: Approach and USACE Experience
49	David	Tazik	US Army Engineer R&D Center	MS	Retrospective Evaluation of Aquatic Ecosystem Restoration Projects Completed by the US Army Corps of Engineers
59	Cassandra	Thomas	Cardno TBE	FL	Restoration of Nutrient-Enriched Everglades through Phosphorus Load Reduction and Fire
1	Cheryl	Ulrich	Weston Solutions, Inc	FL	Everglades, Louisiana Coastal Area and Great Lakes Ecosystem Restoration - Federal and State Implementation and Political Challenges – Lessons Learned
60	Amanda	Watson	Everglades Partners Joint Venture	FL	Decomartmentalization and Sheetflow Enhancement within Water Conservation Area 3: Challenges in Planning for Large-Scale Ecosystem Restoration Projects
27	Sue	Wilcox	U.S. Army Corps of Engineers	FL	Reducing a Nuisance in the Comprehensive Everglades Restoration Plan
6	Jonathan	Winsten	Winrock International	VA	Improving the Cost-effectiveness of Maryland's Cover Crop Cost-share Program using Performance-based Incentives
30	Jing-Yea	Yang	Environmental Consulting & Technology, Inc	FL	Application of Three-Dimensional (3D) Computational Fluid Dynamics (CFD) Modeling in Assessing Flows at Culvert S65AX in South Florida
82	Barry	Rosen	US Geological Survey	FL	Conceptual Ecological Model Updates for the Everglades: Climate Change Considerations

Poster Session II

#	First Name	Last Name	Organization	ST	Abstract Title
63	Andrew	Albaugh	NOAA-NFMS	WA	Web-based, integrated database systems and how they help large scale population management: The ongoing effort to restore the Pacific Northwest Salmonids.
55	Camilo	Arias	USDA Forest Service	FL	South Fork Skokomish Stream Corridor Rehabilitation
71	Steve	Ashby	US Army Corps of Engineers	MS	Modeling in Support of Ecosystem Restoration in Large Ecosystems
11	John	Barras	U.S. Geological Survey	LA	Observations of the Temporal and Spatial Distribution of Hurricane-induced Land Loss in Coastal Louisiana Over the Past 60 Years
1	Richard	Batiuk	U.S. Environmental Protection Agency	MD	How Not to Become Roadkill on the Road to Restoration When Transitioning from Voluntary/Consensus-Based to More Mandatory/Regulatory Approaches
23	Stacey	Blersch	University at Buffalo	NY	A modeling framework for evaluating stream restoration techniques and ecosystem response
34	Beth	Brandreth	US Army Corps of Engineers	PA	Grover's Mill Pond Restoration: Habitat Improvement and Beneficial Use of Dredged Material
75	Laura	Brandt	USFWS	FL	Research, Monitoring, and Modeling in Support of Everglades Restoration: A Collaborative Approach
68	Kelly	Brennan	Parsons Brinckerhoff	MD	Don't Forget About Kermit - A Case Study in Vernal Pool Creation
45	Stan	Bronson	Florida Earth Foundation	FL	International Exchange on Climate Change Adaption in Ecosystems between the United States and the Kingdom of the Netherlands
57	Elvon O.	Childs	Engineering and Research Development Center, US Army Corps of Engineers	MS	Lower Columbia River Large Scale Adaptive Hydraulics Model: Holistic Planning Approach for Ecosystem Restoration in Estuaries
2	Charlotte	Clark	College of William and Mary	VA	Environmental Remediation and Renewable Energy Through High-yield Algal Aquaculture
48	F. Ryan	Clark	ARCADIS U.S., Inc.	LA	Storm Surge and Wave Modeling for Prioritizing Coastal Restoration and Protection Projects
20	Craig	Conzelmann	National Wetlands Research Center	LA	EverVIEW: Bringing Ecological Modeling, NetCDF Data Manipulation and Visualization to the Natural Resource Manager's Desktop
3	Alexis	Coplin	U. S. Army Corps of Engineers	NH	A Landscape Assessment of Nutrient Loading Potential to the Chesapeake Bay

4	Kurt	Dyroff	Ducks Unlimited, Inc.	MD	Ducks Unlimited Annapolis Office: Conservation Strategies for the Chesapeake Bay
41	Jason	Evert	Dial Cordy and Associates	FL	Metrics, Models, and Methods: Predicting Post-Restoration Stream Health
64	Deborah	Fawcett	CSA International, Inc.	FL	Comparison of Artificial Reef Substrates in Qatar
65	Brian	Files	Everglades Partners Joint Venture/Parsons	FL	Program Management Support Contracts in Ecosystem Restoration
21	Tim	Fobes	HDR Engineering, Inc.	MO	Aquatic Ecosystem Restoration of Lake Contrary, a Missouri River Oxbow Lake: Unique Challenges and Planning Analysis Tools
12	Brett	Geesey	HDR Engineering, Inc.	LA	Restoration of Freshwater and Intertidal Wetlands within Louisiana's Chenier Plain
5	Allen	Gellis	U.S. Geological Survey	MD	Targeting Sediment Sources for Restoration Activities
24	Lisa	Huntington	Environmental Consulting & Technology	MI	Successful Restoration – Understanding the Importance of Technical and Social Elements
69	David	Huntress	Stantec Consulting Services Inc.	ME	Restoration of Buckhorn Creek through the Removal of 100-year old Hydro-electric Generating Facility
6	Stephanie	Johnson	National Research Council	DC	National Research Council Evaluation of the Chesapeake Bay Program's Nutrient Reduction Program
38	Billy	Johnson	USACE-ERDC	MS	Training Range Environmental Evaluation and Characterization System (TREECS) Development and Application
36	Meg	Jonas	U.S. Army Corps of Engineers	MS	Reservoir Sedimentation: Linkages to Ecosystem Restoration
7	Patrick	Kangas	University of Maryland	MD	Use of an Algal Treatment System for Water Quality Improvement Along the Susquehanna River
33	Melissa	Kenney	The Johns Hopkins University / Natl. Center for Earthsurface Dynamics	MD	Adaptive Management of Sediment in Rural Watersheds: Evaluating the Worth of Monitoring and Research using Bayesian Inference and Multi-Objective Programming
72	Peter	Kotulak	Moffatt & Nichol	MD	Masonville Dredged Material Containment Facility: Mitigation Design and Implementation Including Upland Remediation and Community Access
13	Fay	Lachney	US Army Corps of Engineers	LA	Challenges of Barrier Shoreline Restoration in Coastal Louisiana
60	Glenn	Landers	U.S. Army Corps of Engineers	FL	An Update on USACE Guidance for Ecosystem Restoration Projects Subject to Impact by Future Sea Level Change

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67	J. Brooke	Landry	Maryland Department of Natural Resources	MD	Deep Creek Lake: Finding the Balance between Recreational Use and Ecological Health
70	Trevor	Langston	USGS	VA	Role of a USGS Hydrologic Monitoring Network in a Landscape-scale Experiment to Reconnect Flow in the Everglades
78	Jamie	Lefkowitz	CDM	MA	Integrated Planning for Ecological Restoration and a City's Increasing Water Resource Demands
8	Justin	Lennon	Parsons Brinckerhoff	MD	Trash Talk: Cleaning up the waters in Baltimore City and the Watershed 263 Trash Collection Program
49	Igor	Linkov	US Army Corps of Engineers	MA	Anthropogenic Renourishment Feedback on Shorebirds: a Multispecies Bayesian Perspective for Beach restoration in the face of Climate Change
39	Mbofho Stanley	Liphadzi	Water Research Commission		The Use of Biological Indicators to Assess Water Quality in South Africa: Analysis of Case Studies, Methods, and Tools
25	Cecilia	Mancini	URS Corporation	PA	Integration of Engineered Bank Stabilization Design Elements to Supplement Habitat Restoration Goals
58	Kathryn	McCain	U.S. Army Corps of Engineers	MO	Information Needs and Difficulties with Floodplain Management
47	Anne	McCarthy	CSA International, Inc.	FL	Restoration of Vessel-Induced Seagrass Habitat Injuries in Biscayne Bay, South Florida: Preliminary Monitoring Data and Recommendations for Future Projects
9	John	McCoy	Columbia Association	MD	Test Your Soi First: Managing Phosphorus at the Home Site
14	Michelle	Meyers	PBS&J an Atkins Company	LA	Louisiana Coastal Area- Restoration of the Maurepas Swamp
26	Sarah	Miller	CEERD	MS	Stability Thresholds and Performance Standards for Flexible Lining Materials in Channel and Slope Restoration Applications
53	Kathleen	Mittmann	Weston Solutions Inc.	TX	Fast Tracked and Low Impact Repairs to Levees and Shoreline, Houston-Galveston Navigation Channel
73	James B.	Murray	USGS	VA	Preliminary Results From the Schooner Bank Core, Everglades National Park, Florida.
40	John	O'Meara	Environmental Consulting & Technology, Inc.	MI	Urban Ecosystem Bluff Restoration Project
16	Alaina	Owens	Brown and Caldwell	LA	Louisiana's Coastal Impact Assistance Program (CIAP) - Cutting Edge Projects, Implementation Challenges and Successes
17	Alaina	Owens	Brown and Caldwell	LA	Louisiana's Coastal Forest Conservation Initiative and the Spatial Decision Support System

15	Monica	Palaseanu-Lovejoy	Jacobs Tech. / USGS	FL	Impact of Temporal Autocorrelation on Land Loss Modeling in the Coastal Louisiana Deltaic Plain
61	Melanie	Parker	Florida Fish and Wildlife Research Institute	FL	Monitoring Oyster (<i>Crassostrea virginica</i>) Populations at Reef Habitat Restoration Sites in the St. Lucie and Loxahatchee River Estuaries
27	Damian	Preziosi	Integral Consulting Inc.	MD	Using Landscape Connectivity Models to Inform Prioritization of Restoration Projects
37	Richard	Price	USAERDC	MS	Sustainable Dredged Material Management Through Beneficial Use
32	Molly	Reif	USACE/ERDC	MS	Mapping Submersed Aquatic Vegetation Species Using an Airborne Hyperspectral/Lidar System
35	Jason	Rinker	U.S. Army Corps of Engineers	MD	Stormwater Outfall and BMP Assessment
19	Stephanie	Romanach	U.S. Geological Survey	FL	Ecological Models and Tools for Greater Everglades Restoration
28	Laura	Rozumalski	Baird and Associates	WI	Culvert Retrofit and Stream Channel Restoration to Insure Fish Passage along Fond du Lac Creek, near Cloquet, MN
18	Kip	Runyon	US Army Corps of Engineers	MO	Terrebonne Basin Marsh Restoration: Challenges in Louisiana Coastal Area Ecosystem Restoration
50	Dan	Salas	Cardno JFNew	WI	Stream Daylighting and Restoration in the Indiana Dunes State Park and National Lakeshore
29	Heather	Schwar	HNTB	WI	Low-Flow Model for Tres Rios Environmental Restoration, Phase 3A
62	Cat	Shrier	Watercat Consulting LLC	DC	Development and Acceptance of Knowledge Based Systems for Spatial Decision Support Systems to Evaluate Streamflow Augmentation Recharge and Waterfowl Habitat Pond Sites
42	Thomas	Smith III	U. S. Geological Survey	FL	A Land of Flowers on a Latitude of Deserts: Aiding Management and Conservation of Florida's Biodiversity using Downscaled Climate Scenarios with Ecological and Hydrological Models
66	Richard	Snyder	University of West Florida	FL	Restoration of Gulf Coast Wet Prairie Habitat from Slash Pine Plantation.
30	Tom	St. Clair	Everglades Partners Joint Venture	FL	Organizing New Science to Adaptively Manage a Restoration Vision: Lessons Learned from the Everglades
74	Bethany	Stackhouse	U.S. Geological Survey	VA	Selected Molluscan Species as Tools for Restoration of the Greater Everglades Ecosystem, Florida

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76	Andrew	Struck	Ozaukee County	WI	Coordinating a Multi-Year, Multi-Million Dollar Watershed-Wide Fish Passage Program – A Case Study of Major Dam Natural Fishways and Removal - Coordination of Partners, Public Input, Funding, and Other Resources for Measurable Outcomes
77	Leslie	Suazo	Brown and Caldwell	LA	Strategic Stakeholder Engagement Crucial to Building Broad-based Support for Large Scale Coastal Protection and Restoration Efforts in Louisiana
43	Eric	Swain	U.S. Geological Survey	FL	Evaluating the Potential Impacts of Sea-Level Rise and the Comprehensive Everglades Restoration Plan (CERP) on South Florida using the Biscayne and Southern Everglades Coastal Transport (BISECT) Model
10	PETER	TANGO	U.S. GEOLOGICAL SURVEY	MD	Criteria, Monitoring and Assessment: Support for Chesapeake Bay TMDL Pollution Diet Development and Tracking Health Progress.
59	Chuck	Theiling	U.S. Army Corps of Engineers	IL	Opportunities for Climate Change Adaptation in Upper Mississippi River Leveed Floodplains
31	Heather	Tipton	U.S. Fish and Wildlife Service	FL	A Multi-Species Transition Strategy for Everglades Water Conservation Area 3A
51	Peter	Tomsovic	RECON Environmental, Inc.	CA	Establishing High Marsh Habitats within the San Dieguito Lagoon Wetland Restoration Project
56	Russ	Weeks	U.S. Army Corps of Engineers	FL	Everglades Restoration Climate Change Modeling Needs
52	Daniel	Wilcox	U.S. Army Corps of Engineers	MN	Increasing Longitudinal Aquatic Habitat Connectivity on the Upper Mississippi River System

Workshops

Assessing Cumulative Ecosystem Effects of Multiple Restoration Projects

Workshop Background and Objective:

The intent of this workshop is to present an approach to answering the question, “When can we conclude that conservation and restoration projects have together made a significant improvement in the ecosystem?” Because of the high cost of restoration projects, it is critical to document whether actions are successful. Therefore, the development of methods to measure “net ecosystem improvement” at large scales is also important. Although large-scale restoration programs are beginning to supplement isolated projects in tidal waterways, generally their effects continue to be evaluated at project scales or in an additive manner. Instead, lessons from assessing cumulative effects of ecosystem degradation can be applied ‘in reverse’ to evaluate the interactions among restoration projects in larger programs. This workshop will focus on the lower Columbia River, a large tidal river/estuary system, but the approach presented should have applicability to the evaluation of restoration programs in other ecosystems. Topics addressed will include the theory underpinning cumulative effects analysis, a ‘levels of evidence’ approach to addressing cumulative effects, selection of performance assessment metrics, development of monitoring protocols, performance goals, scales of analysis, identification of critical uncertainties, how to ‘roll up’ results, use of project prioritization frameworks, and adaptive management.

Session Organizers:

Ronald M. Thom leads the Coastal Ecosystem Research technical group at the Pacific Northwest National Lab’s Marine Sciences Laboratory in Sequim, Washington.

Blaine D. Ebberts is a Senior Fisheries Biologist with Portland District, Corps of Engineers, and has over 25 experience of research and program management experience.

Challenges and Opportunities Common to Large-Scale Adaptive Management Programs

Summary: CAMNet is dedicated to the advancement of practical applications of Adaptive Management and collaboration. One method CAMNet employs is to hold an interactive session that brings a diverse group of CAMNet members together with the leaders and stakeholders of a program actively applying Collaborative Adaptive Management. The interactive session provides an opportunity for the leaders and stakeholders of the local program to use CAMNet as a sounding board for their thoughts and application efforts. CAMNet members are able to learn from the local program and share their insights and experiences with the program leaders and stakeholders. The diversity of the CAMNet members will provide access to a broad and deep experience in applying Adaptive Management that is not easily assembled or conveyed in other forums. The session will be less focused on a specific outcome and more focused on producing healthy and useful dialog among the participants. The dialog will be primarily between the CAMNet members and the leaders and stakeholders of the local program, but will provide opportunities for interactions with the larger audience attending the session.

Workshop Objective: Explore opportunities for large-scale ecosystem restoration programs to work together to implement solutions to common challenges

AGENDA

- 9:00 a.m. Welcome, Introductions, and Agenda Review**
- 9:30 a.m. Identification of Issues/Challenges Common to Large Scale Adaptive Management Programs**
- *Collaborating with non-governmental stakeholders within the context of FACA*
 - *Adaptive governance – making adjustments within existing decision making structures, processes, rules*
 - *Other?*
- 10:15 a.m. Identification and Evaluation of Options for Addressing Common Challenges**
- *Would it be beneficial for AM Programs to work together to address any of these issues?*
 - *If so, which ones? What strategies would be most effective if implemented collectively?*
- 11:30 a.m. Next Steps**
- 12:00 p.m. Adjourn**

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New Strategies and Tools for Organizing and Funding Large-scale, Regional Ecosystem and Watershed Restoration

Offered by Storm Cunningham, CEO of REVITALIZ, LLC, Washington, DC

Workshop Background:

Research into ecological restoration and technical tools for discrete, fairly self-contained projects has been advancing at a rapid pace over the past decade. The same cannot be said for open-ended, regional, large-scale projects and programs.

At this level, integrating the renewal of the natural, built, and socioeconomic environments comes into play—not to mention the political challenges of dealing with multiple jurisdictions, multiple funding agencies, and multiple private property owners. The resulting complexity, and sheer volume of challenges, has scared-off most efforts to bring rigor to the process. As a result, regional ecological renewal is largely an *ad hoc* process.

This workshop will introduce tools and strategies have recently been introduced to address these complex challenges.

Workshop Objective:

The objective of the proposed workshop is to acquaint attendees with software and approaches to dealing with the challenge of integrating the many forms of renewal that must be addressed when planning or implementing large-scale ecological and/or watershed restoration projects. These include infrastructure, agriculture, fisheries, historic/cultural assets, commercial assets, brownfields remediation/redevelopment, catastrophe recovery, and community revitalization goals, to name just a few.

These tools and approaches are also designed to simplify the process of effectively engaging all public and private stakeholders, funders, planning agencies, economic development agencies, and other resources. Proper use of these tools results in more resilient projects and programs that are properly supported and funded throughout their lifecycle.

Workshop Instructor:

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Field Trips

OPTIONAL Pre-Conference Technical Training Field Trip

Poplar Island: Paul S. Sarbanes Environmental Restoration Site

Sunday, July 31, 2011

Itinerary:

7:30am	Bus departs Baltimore Marriott Hotel
9:30am	Arrive at Tilghman Island
10:00am	Boat ride to Poplar Island
10:00am-1:00pm	Tour, lunch and lecture on Poplar Island
1:30pm	Boat ride back to Tilghman Island
2:00pm-4:00pm	Bus returns to Hotel



Poplar Island, recently on the verge of disappearing, is today a national model for habitat restoration and the beneficial use of dredged material. The U.S. Army Corps of Engineers, Baltimore District has teamed with the Maryland Port Administration and other Federal and State agencies to restore Poplar Island using dredged material from the Baltimore Harbor and Channels Federal navigation projects (only approach channels). Just off the Chesapeake Bay coastline, about 34 miles south of Baltimore in Talbot County, MD, Poplar Island is being returned to its former size and important ecological function while helping to ensure the economic vitality of the region. Approximately 68 million cubic yards (mcy) of dredged material will be placed to develop 735 acres of wetlands, 840 acres of uplands and 140 acres of open water embayment.



At completion, Poplar Island will be half upland habitat and half wetlands. Trees, shrubs, and grasses will be planted in the uplands and the area will support terrapins, birds and mammals including foxes, raccoons, squirrels and deer. The wetlands will be a combination of low marshes and high marshes. Low marshes are wetland habitats that are regularly flooded by tidal waters. High marshes are infrequently flooded due to strong winds or exceptionally high tides. The

wetlands will be planted with a variety of plants to provide habitat for a wide range of animals including, fish, shrimp, crabs, shorebirds, wading birds, and mammals.

Patapsco River Dam Removal Projects: Bloede Dam, Simkins Dam and Union Dam

Wednesday, August 3, 2011

Itinerary:

11:30am	Bus departs Baltimore Marriott Hotel
11:30am-12:15pm	Travel to Patapsco Valley State Park
12:15pm-1:30pm	Picnic lunch at Patapsco Valley State Park (Bloede Dam site) presentations by Mary Andrews and Serena McClain
1:30pm-2:00pm	Tour of Bloede Dam site
2:00pm-2:15pm	Travel to Simkins Dam Site
2:15pm-3:15pm	Tour of Simkins Dam site with demonstration by Maryland Biological Stream Survey
3:15pm-3:30pm	Travel to Union Dam Site
3:30pm-5:00pm	Union Dam Site Visit
5:00pm-5:30pm	Bus returns to Hotel



Bloede Dam is 220 feet long, 40 feet wide at the base and has a drop of 26.5 feet. It is an Amburson Hydraulic Construction Company (Boston type) reinforced concrete slab and buttress dam. It was the first known instance of a submerged hydroelectric plant where the power plant was housed under the spillway. It is also recognized as one of the earliest dams constructed of reinforced concrete.

Simkins and Union Dams will have been removed. The former sites of these dams will be visited. Union Dam was removed from October 2009 to September 2010 using a heavily engineered approach with multiple river diversions and realignment of the stream channel. In contrast, the Simkins Dam removal used a passive sediment management approach releasing approximately 80,000-100,000 cubic yards of sand and gravel that was stored behind the dam. Intensive monitoring of the site has been conducted with its removal and data will be shared at the site visit.



Smithsonian Environmental Research Center (SERC)

Wednesday, August 3, 2011

Itinerary:

- 11:30am Depart Baltimore Marriott Hotel
- 11:30am-12:15pm Travel to SERC
- 12:30pm-2:00pm Picnic Lunch and Presentation by Dr. Pat Megonigal with a visit to the CO2 study site
- 2:15pm-3:15pm Talk by Dr. John Parker
- 3:15pm-4:00pm General SERC Talk by Karen McDonald
- 4:15pm-6:00pm Bus returns to Hotel



Participants will be introduced to the research conducted at the Smithsonian Environmental Research Center by meeting with two research scientists and then will be presented with a general overview of all the research conducted at the 18 different laboratories housed onsite. The first speaker, Dr. Pat Megonigal works in the Biogeochemistry lab and will discuss the impacts of global climate change on plants and intertidal zones, relating specifically to CO2 and sea level rise. During this talk participants will be shuttled to the world’s longest running CO2 study site to look at the chambers used for this research. Next Dr. John Parker will discuss the impacts of invasive species on ecosystem landscapes, and herbivory by large mammals. His research speaks directly to human impacts on native ecosystems. The last talk of the day will be an overview of the other 16 laboratories at SERC and their global and local research. Laboratories discussed will include the Fish and Invertebrate Lab, Plant Ecology Lab, Plant and Animal Interaction Lab (Mangroves), Nutrient Ecology Lab, Marine Invasive Species Lab and more!



Tidal Wetland and Vernal Pool Restoration Site

Wednesday, August 3, 2011

Itinerary:

11:30am	Depart Baltimore Marriott Hotel Eat box lunch on bus in transit to site
12:30pm-2:30pm	Arrive at Cox Creek Mitigation Site and tour
2:45pm	Leave for Hollyneck Mitigation Site
3:00pm-5:00pm	Arrive at Hollyneck Mitigation Site and tour
5:15pm	Leave for Dinner
5:30pm	Arrive at Al's Seafood Restaurant www.als-seafood.com
7:30pm	Bus returns to hotel



The Cox Creek mitigation site is associated with the Cox Creek Dredged Material Management Facility (DMMF). The reconstruction of the Cox Creek DMMF resulted in the need for mitigation. The 12-ac mitigation site was an 8-ac mono-typic *Phragmites* stand and a four-acre still pond (both above the influence of tide). The mitigation project involved the excavation and removal of the *Phragmites*, lowering the site into the intertidal range.

The mitigation target was to create a mosaic of unvegetated open water, vegetated marsh, and a beach strand dominated by supra-tidal shrub community. This was accomplished through over-excavation of areas to create sub-tidal ponds, grading of other areas to intertidal marsh elevations for both *Spartina alterniflora* and *Spartina patens* communities, and either retention of beach strand or building-up of beach strand to an elevation above normal tidal influence. A tidal channel connection was created, and the site was planted. The presence of Canada geese led to erection of exclusion fencing across the site.



Urban Stream Restoration Site

Wednesday, August 3, 2011

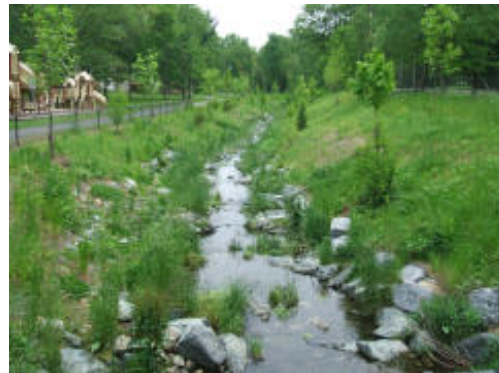
Itinerary:

11:30am	Depart Baltimore Marriott Hotel Eat box lunch on bus in transit to site
12:30pm-1:30pm	Arrive at Spring Branch and tour site
1:30pm	Leave for Mine Bank Run
1:45pm-3:45pm	Arrive Mine Bank Run and tour site
4:00pm	Leave for Stony Branch
4:15pm-5:15pm	Arrive Stony Branch and tour site
5:30pm	Leave tour site
5:45pm	Arrive at Brewers Art (dinner on your own) www.thebrewersart.com/housebeer.html
7:30pm	Bus returns to hotel



The first stop at Spring Branch, an eroding headwater stream system, will focus on a more than 10-yr old restoration project which included the restoration of a concrete trapezoidal channel.

The second stop will be at Mine Bank Run, a restoration project which has been the focus of years of research and monitoring. In addition to describing the restoration, we will discuss the results of the University of Maryland's site studies.



The final stop will be Stony Branch, a more recent approach to stream restoration involving the removal of legacy sediments and restoration of the relationship between the stream and its floodplain. This project was controversial and occupied the local news for weeks as a result of the removal of the forested riparian cover to restore floodplain connection.

Fishing Excursion

OPTIONAL

Wednesday, August 3, 2011 (5 pm – 12am)

COST: \$120 per person (10 people per boat)

Chesapeake Bay Mixed Bag Fishing

Joe Pfeiffer with **KCI Technologies, Inc.** has volunteered to organize charter boats for an OPTIONAL fishing excursion on Wednesday evening during the conference.

The Chesapeake Bay is the host to a variety of game fish species. Late summer fishing is a mixed bag approach targeting rockfish, spot, flounder, perch croaker, Spanish mackerel, and bluefish by live lining, bottom fishing, trolling, jigging and chumming. Van transportation leaves the hotel at 5pm for the docks, and departure from the docks in Deal Md (south of Annapolis) is at 6pm. Boats return to dock at 12am. Evening trips offer a cool respite from the heat of the day and the unique opportunity to watch the sunset on the bay. The trip will be aboard 48' Bay style charter boats as "make up" charters with approximately 10 people to a boat.



Transportation from the conference hotel will be organized for those participating. Transportation, snacks and drinks provided. ***No license or tackle is required.*** When you register online for the conference, indicate you wish to participate in this OPTIONAL event. When you get to the PAYMENT SCREEN, you can split your registration payment and use a second, personal credit card to pay for the fishing excursion.



Questions about the Excursion?

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Special thanks to Joe Pfeiffer and KCI Technologies for their help in coordinating this event and sponsoring transportation to and from the fishing excursion.

Special Sessions

Monday, August 1, 2011 – 5:00pm

PLENARY SOCIAL - The Future of NCER

[Harborside Ballroom - 4th Floor]

MODERATOR: Cheryl Ulrich, Weston Solutions

Join us for refreshments as we discuss the future of NCER. The National Conference has continued to grow and now brings together nearly 1,000 scientists, engineers, policy makers, planners, and partners from across the country that are actively involved in ecosystem restoration. It is an interdisciplinary conference presenting state-of-the art science and engineering, planning and policy in a partnership environment. Recommendations from the National Research Council and the US Army Corps of Engineers Environmental Advisory Board stress the need for leadership in the ecosystem restoration arena in order to achieve success. In addition, attendees at past National Conferences on Ecosystem Restoration have requested some form of collaboration bridging our biennial conferences.

The concept of a National Community for Ecosystem Restoration was initially launched at the National Conference for Ecosystem Restoration 2009. Two feedback forums held during NCER 2009 were the leadership summit and the closing plenary session. In addition, a questionnaire was distributed to the entire list of NCER attendees to obtain feedback. The concept was also presented at the Annual American Water Resources Conference in November 2009 and the Greater Everglades Ecosystem Restoration Conference 2010. Approximately 50 volunteers who are national senior leaders in the field of ecosystem restoration have been working very diligently to take the National Community for Ecosystem Restoration to the next level through participation in Mission, Implementation and Governance sub-teams. This past year NCER representatives have been undergoing discussions with the Society for Ecological Restoration regarding a potential merger. Please join us to share your thoughts regarding our next steps.

Tuesday, August 2, 2011 – 5:00pm

USGS Plenary "Listening Session" with State & Federal Agency Representatives

[Harborside Ballroom - 4th Floor]

MODERATOR: Lynn Wingard, US Geological Survey

This session will elicit feedback from stake-holders, cooperators and agency representatives as part of a "restructuring" of USGS mission areas by the Ecosystem Science Strategy Planning Team. Please make plans to stay for this session and provide valuable input as USGS works to restructure its missions areas.

Wednesday, August 3, 2011 – 6:00pm

Public Lecture: Science to Inform Chesapeake Bay Restoration Efforts: A Discussion of Land Use, Water Quality, Fish and Wildlife Conditions

[Harborside A/B]

Presenters: USGS Scientists Peter Claggett, Vicki Blazer, and Alicia Berlin

The Chesapeake Bay has long been a favorite destination for Maryland and District of Columbia area residents to escape city stress and relax. The Chesapeake watershed also provides important habitat for many fish and wildlife species. However, the 17 million people in the Bay watershed have contributed to its decline over the past several decades. But, a new optimism is spreading among scientists and resource managers working to restore the Bay. Join USGS Chesapeake Bay studies scientists Peter Claggett, Vicki Blazer, and Alicia Berlin, as they discuss the new science and cooperative efforts being applied to understand the factors contributing to ecosystem health and to restoring the Nation's largest estuary and its watershed.

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Fourth National Conference on Ecosystem Restoration (NCER)

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Abstracts

(Alphabetical by presenting author's last name)

Web-based, Integrated Database Systems and How They Help Large Scale Population Management: The Ongoing Effort to Restore the Pacific Northwest Salmonids

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The Pacific Northwest is home to over 200 distinct populations of wild salmon. As it has been well documented over the previous decades the natural abundance of many of these populations have been declining throughout the Puget Sound, Columbia River basin, and coastal Oregon regions. Under the Endangered Species Act each population has the potential to be listed as threatened. The amount of data analysis that is needed to determine the listing status of these fish is immense. At the Northwest Fisheries Science Center (NOAA) we are working to streamline this data analysis effort through the creation of integrated, web based, and geographically referenced databases.

Final salmon population abundance numbers and decadal trends are reliant on a multitude of factors. These factors include spawning ground counts, carcass counts, juvenile estimates, hatchery abundance and influence, and habitat use. Our Salmon Population Summary Database, Artificial Propagation Database and Pacific Northwest Salmon Habitat Project Tracking Database all combine to give those tasked with listing and de-listing these salmon populations as much easily discernable information as possible. Furthermore, we are creating extensive data dictionaries which are created to stand alone and paint a complete picture of the intricate often misunderstood inter-agency dataflow process, as well as a complete record of final stage data management methods.

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Latex Recovery and Process Water Treatment, Liberia, West Africa

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Firestone Liberia has operated a rubber cultivating estate in Harbel, Margibi County, Liberia, West Africa since 1926. In 2006, Firestone initiated large-scale capital improvements in the areas of water quality treatment and disposal. HSA was selected to design and construct a collection and treatment system to reroute millions of gallons per day of facility wastewater away from the Farmington River, and then treat the effluent. Because the discharge included storm water that had combined with wastewater due to the lack of roofing, gutters, and conveyances at the plant, a secondary goal of the system was to separate the wastewater and storm water runoff elements. The wastewater portion of the current flow, largely resembles that of a domestic sewage, and can be treated in much the same manner as is often accomplished in the United States and other developed countries. Use of a low-lying and vegetated area that thrives on saturated soil conditions (i.e., a “wetland”) makes an excellent venue for the “polishing” of the water, removing any residual human or environmental threats and allowing for the possibility of water reuse, especially during the drought of the summer months. Primary wastewater treatment occurs within a series of three large aboveground storage tanks constructed at the rubber processing facility. The first tank “equalization” tank, ensures that the wastewater flow is consistent and not subject to changes in daily facility throughput, or seasonal decreases/increases due to both drought and monsoon conditions. Aeration is employed to create an environment that encourages bacteria to thrive using the contaminants in the process wastewater as a readily available food source. The next two (smaller) tanks are used to reduce the amount of solids generated from the equalization tank including biosolids and pieces of rubber and dirt. This second stage is termed “clarification” removes settleable and floating solids, typically representing 50 to 70 percent of the Total Suspended Solids, and 25 to 40 percent of Biochemical Oxygen Demand. Secondary treatment is accomplished through use of a local natural wetland system situated several miles from the factory. Natural wetland systems act as bio-filters removing sediments and pollutants such as nitrogenous compounds from the water. The vegetation in a wetland provides a substrate (via its roots, stems, and leaves) upon which microorganisms can grow as they breakdown organic materials. Periphyton along with natural chemical processes, are responsible for approximately 90 percent of the pollutant removal and waste breakdown. Wetlands have the added advantage of limited environmental disruption (very little vegetative maintenance is necessary in natural wetland treatment systems), and tolerance to differing flow and pollutant loading rates. The use of natural wetlands also represents an ecological solution or “Green Technology,” requiring lower power consumption and CO₂ production. Finally, and in addition to the treatment approach described above, the project has been designed to include provisions for future water reuse at the factory during seasonal drought periods where there is limited availability to process water.

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Using Systemwide Assessments of Habitat Condition in the Atchafalaya Basin to Identify and Evaluate Management Improvements

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The Atchafalaya River in south Louisiana is a regulated distributary of the Mississippi River. As it flows south through swamps of the Atchafalaya Basin, it drives geomorphology and habitat conditions within the Basin and in coastal Louisiana. The amount, quality, duration, and flow rate of water define the availability and quality of habitats for flora and fauna living in the Basin. Through the years, accretion through both natural and engineered processes has led to a segmented complex of lakes, rivers, canals that have become increasingly isolated from the River resulting in reduced water quality. The Louisiana Department of Natural Resources Atchafalaya Basin Program (LDNR) is seeking to identify and prioritize management solutions that will address these challenges. In an effort to more objectively evaluate management plans and decision making within the Basin on a systemwide basis, the LDNR is supporting the development of the Natural Resources Inventory and Assessment System (NRIAS). The system relies on a geospatial interface to reference a wide diversity of scientific data and management information. The primary systemwide resource is library of Landsat imagery collected from 1983-present. The imagery and related analysis products are used in conjunction with elevation maps to determine water quality and water flow patterns within proposed project areas and examine how these patterns change with changing river levels. Historical maps are used to determine past conditions and patterns of land change. Polygon assessment units are also being developed which will serve as the primary spatial backbone to assign habitat attributes to smaller management-sized areas. A webmap interface is being developed to make these data available to the public and offer an interactive means to solicit public projects and comment in a more meaningful and transparent context .

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Environmental Benefits of an Urban Stream Restoration: From Stink Creek to Beautiful Stream

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Nine Mile Run is one of the last remaining free flowing streams in the City of Pittsburgh, Pennsylvania. Historically the stream was subjected to slag dumping (a by-product of the steel industry), raw sewage flows, and essentially contained no fish and very little macro-invertebrates or other aquatic life. Over the years, most of the stream has been culverted except for the lower 1.9 miles which runs through a city park known as Frick Park. By 1998, the stream suffered from a wide fluctuation of flow conditions, combined sewage overflows during wet weather, damage by mountain bike riders, stream bank erosion and a general lack of form and sinuosity. Through the U.S. Army Corps of Engineers Aquatic Ecosystem Restoration Program (known as Section 206), the Corps partnered with the City of Pittsburgh to reconstruct the stream. The result has been a dramatic increase in ecosystem values. For example, total fish species, number of fish, and the overall biomass of fish sampled increased 140, 130, and 650 percent respectively between pre and post project sampling in the first two years alone.

Another key offshoot to the project has been the formation of the Nine Mile Run Watershed Association. The NMRWA has been actively coordinating the monitoring of the stream and its associated ecosystem since 2001. The watershed association has also acted as a “watch dog” organization and catalyst to keep the stream restoration functioning effectively and has been assisting the City of Pittsburgh with ongoing maintenance/adaptive management of the stream since the Section 206 project was completed in 2006. This once was a stream which literally smelled in dry weather and raged in wet weather, thereby preventing any meaningful recreation use. Although not yet perfect, the ongoing efforts of the partners has continued to resolve more of the stream’s many problems and the stream has become a benefit to the community rather than a detriment. A secondary, but equally important result, has been an increase of stewardship toward the stream by many different groups and individuals in the local community; from college students to senior citizens and school groups.

This presentation will discuss the many challenges in the original construction as well as the “adaptive management” techniques used to keep the restoration intact and continuing to function well. It will also describe the important roles of the many partners involved as well as describing the monitoring results of fish, insects, and plants in and around the restored stream. Due to the monitoring, there is an abundance of pre and post project data which enables this stream to serve as a case study, especially as related to an urban stream setting. The “lessons learned” from the process can provide examples for other such challenging urban stream restorations.

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Designing and Implementing Dam Removal Projects in the Context of the Regulatory Climate: The Simkins Dam Removal Case Study

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Dam removal is an evolving field where, as removals continue to gain traction as a respected river restoration technique, hot button topics and complicated engineering questions are emerging that bifurcate the restoration, engineering and regulatory community. The American Society of Civil Engineers (ASCE) in their 2009 report card on infrastructure gave dams a failing “D” grade citing that over the past six years, for every deficit, high-hazard dam repaired, nearly two more are declared deficit. ASCE projected a five year funding shortfall of over \$7.45 billion to address safety concerns and repairs associated with dams. With the average age of dams in the United States exceeding 50 years, the lack of funding allocated for critical maintenance and the ecological gains associated with their removal, more dam owners are investigating the option of removal. The Simkins Dam Removal project will be used to examine key issues impacting dam removal projects in the context of the latest in scientific research, engineering practices and political climate. The practical applicability of these issues, such as sediment management, will be discussed in light of their real-life constraints.

The Simkins Dam was a 10-ft high concrete dam on the Patapsco River within the Patapsco Valley State Park area two miles east of Ellicott City, Maryland. The dam had a 170-foot long concrete spillway and an impoundment of roughly 3500 feet long and approximately 10 acres. The dam was located just upstream of the 34 foot high Bloede Dam. NOAA, American Rivers, and other partners contracted with Interfluve to design the removal of the Simkins Dam. Together with the Bloede Dam removal and the recent removal of the Union Dam, the Simkins removal will restore fish passage to over 40 miles of the Patapsco River. Dam removal will result in passage for diadromous fish (alewife, blueback herring, American eel), free flowing river conditions, restored sediment transport processes and reduce safety concerns related to an aging dam structure in a waterway heavily used for water-based recreational activities.

Dam removal alternatives considered during the design process included full dam removal with excavation of 100,000 cy of material (removal of all sediment behind dam), partial excavation of sediment behind the dam, and removal of dam with a passive sediment management approach. This presentation will focus on the regulatory requirements and design information required to permit the passive sediment management approach, including the DREAM sediment transport model, soil analysis for grain size and contaminants, adaptive management plan, and monitoring approach. We will also investigate the real life implications of permit requirements during construction, modifications made to sediment and erosion control features and compare and contrast alternative approaches for a dam removal completed just upstream of the Simkins site.

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A Roadmap and Weigh Stations: Creating an Accountability System for Implementing a Multi-Jurisdictional TMDL in the Chesapeake Bay Watershed

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The U.S. Environmental Protection Agency (EPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL) for Nitrogen, Phosphorus and Sediment in 2010 to set limits on the amount of pollutants that the nation's largest estuary can receive and meet water quality standards. This historic "pollution diet" is accompanied by a rigorous accountability framework to ensure that nutrient and sediment controls are in place by 2025. Here we describe how components of the accountability framework – including Watershed Implementation Plans, the TMDL, 2-year milestones, and federal backstop actions – differ from previous agreements and initiatives to restore clean water in the Bay and its tributaries.

Since 1983, the Chesapeake Bay Program partnership has embraced voluntary, regulatory and management initiatives to analyze and reduce nutrient and sediment loads delivered to the Bay. However, insufficient progress and continued water quality impairments led EPA to establish the TMDL under the federal Clean Water Act. EPA included the rigorous accountability framework within the TMDL to demonstrate assurance that allocations to source sectors in the seven Bay jurisdictions would be achieved and maintained through a combination of federal, state and local actions.

Watershed Implementation Plans, or WIPs, provided the seven Bay jurisdictions with the opportunity to create the roadmap for restoration. Specifically, WIPs identified how much each source sector would reduce nutrient and sediment loads in order to meet water quality standards in tidal waters. The WIPs also included strategies and schedules to demonstrate and how and when reductions would occur. The TMDL formalized these allocations and the underlying assumptions within a legally binding document.

Restoration is a long-term effort, and Chesapeake Bay Program partners recognized that near-term check-ins will facilitate mid-course corrections before deadlines are missed. The seven jurisdictions therefore agreed to divide nutrient and sediment reductions into 2-year milestones. EPA has committed to evaluate these milestones and, as necessary, take federal actions to ensure that all nutrient and sediment controls are in place by Chesapeake Bay Program's goal of 2025.

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South Fork Skokomish Stream Corridor Rehabilitation

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In 1952, a dam was proposed for the South Fork Skokomish River in the Olympic Mountains in Washington State. The floodplain area above the proposed dam was logged and large woody debris (LWD) within the stream was removed. Due to geologic concerns of fault lines, the dam project was abandoned. In addition to this disturbance, conditions within the watershed have been degraded by riparian timber harvest, removal of instream LWD, increased sedimentation from timber harvest-generated landslides, and surface erosion from road construction. Due to the poor riparian and stream channel conditions, water temperature maximums have exceeded state water quality standards and the river was listed as 303(d) impaired waters by Washington State Department of Ecology. Additionally, several fish species native to the South Fork Skokomish watershed including pink salmon (*Oncorhynchus gorbuscha*), Chinook salmon (*Oncorhynchus tshawytscha*), and chum salmon (*Oncorhynchus keta*) are thought to be extirpated from the watershed due to over-fishing and watershed degradation.

A threefold restoration strategy was established on a 2.1 mile river stretch, giving priority to restoring floodplain resiliency and resistance to flow as well as stream channel and bank stability, followed by restoration of riparian vegetation, to ultimately improve fish habitat and fisheries production. Channel geometry equations, hydraulic modeling, stream flow patterns, and disturbed analogous or reference reaches of stream were used to develop rehabilitation designs and implementation templates. Channel and floodplain stability was accomplished by the construction and strategically placement of log jams and LWD structures on floodplains, tributary fans, and on the bankfull perimeter. Log jam construction and LWD structure placement was designed to emulate stable natural LWD accumulations, in order to reduce streambank and terrace erosion, increase floodplain roughness, promote establishment of riparian vegetation, and increase habitat for aquatic organisms and threatened fish species. The project was also designed to use whole length second growth trees without cable, bolts or ballast.

Implementation took place during the summer of 2010. On December 2010, LWD structures and restoration efforts endured a 50-year flood event (16,200 cfs). All structures were still present after the event and exhibiting adequate channel and floodplain protection. Therefore, utilization of second growth trees 30-6 inches in diameter for LWD structures, readily available and cost effective, appeared to be a feasible option at large river system/reach scale restoration efforts. Larger trees or logs are not necessarily better, particularly if the structure elements are well buried, and to the greatest extent possible log pieces are knitted so they are a cohesive whole. Additionally, structure design and placement of key log pieces buried into streambanks, gravel bars, and floodplains for stability has shown to be a viable alternative to the use of traditional anchoring methods such as ballast, cables, or bolts.

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Ecosystem Restoration on the Truckee River, Nevada: Integrating Ecosystem Restoration with Flood Risk Management in a High-desert Landscape

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Like most rivers in the arid west, the Truckee River is at the center of a struggle between supporting a growing human population and sustaining a delicate riparian and aquatic ecosystem. Add human safety to the equation and the effort to find the right balance between ecological function, water supply, and managing the risk of flooding becomes a very complex endeavor. The Sacramento District of the U.S. Army Corps of Engineers (Corps) and its partner, the Truckee River Flood Project Coordinating Committee, have been developing a multi-purpose project that addresses the chronic flooding problems experienced by the Reno/Sparks Metropolitan area while integrating an ecosystem restoration component that looks to restore the river's ecological function that has been lost largely due to anthropogenic stressors. This presentation focuses on the process of identifying appropriate restoration measures, and formulation and evaluation of restoration plans compatible with proposed flood risk management features and consistent with the National Ecosystem Restoration objective.

While the majority of the flood risk management focuses on the urban corridor of Reno and Sparks, ecosystem restoration opportunities are integral features not only within this 5-mile urban reach, but also along 26 miles of the river downstream of the urban area. The downstream features aim to restore hydrogeomorphic structure and function as well as restore riparian habitat quantity and quality. A recognized need for improved movement of fish around almost 30 barriers led to the inclusion of fish passage improvement features at 9 of the most critical dams and diversions of the river.

The formulation and selection of a restoration plan follows the Corps' six-step planning process. Evaluation and comparison of alternative restoration plans focuses on quantitative and qualitative restoration outputs. Plan selection looks to reasonably maximize ecosystem restoration benefits compared to costs, consistent with the Federal objective.

Restoration outputs for this study were derived from implementing the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP) for riparian restoration. Benefits realized from hydrogeomorphic restoration were quantified using a modification to the U.S. Environmental Protection Agency Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers and normalized to be compatible with HEP outputs. Fish passage improvement benefits were evaluated separately and were quantified using an Environmental Benefits Assessment model developed by the Corps' Engineering Research and Development Center Environmental Laboratory and adapted from the benefit scoring system developed for northwest anadromous salmonids by the Washington Department of Fish and Wildlife.

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Modeling in Support of Ecosystem Restoration in Large Ecosystems

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The U.S. Army Corps of Engineers (COE) has been tasked with missions to provide navigable waterways, reduce the risk of flooding, and provide environmental stability for the Nation's water resources. Maintenance of navigable waterways and flood risk reduction alters flow regimes and can have adverse impacts on ecosystems such as change in habitat quantity, quality, type, and distribution. These impacts result in changes in ecosystems such as community structure, population densities and biomass, biodiversity, and increased opportunity for invasive species. As a result of navigation and flood risk reduction activities, many ecosystems have experienced degradation and efforts to restore or rehabilitate these systems are increasing as part of the COE mission. Quantification of benefits and forecasting ecological associated with ecosystem restoration is required by COE Planning, Operations, and Engineering for sustainable water resources and ecosystem management.

A suite of ecological models has been developed for restoration activities. Many of these models are coupled with hydrodynamic and hydrologic models to integrate water resource management with ecosystem restoration. Often the emphasis is on returning ecosystem functions to desired conditions. Focusing on ecosystem functions in aquatic environments requires understanding and representation of hydrologic and hydrodynamic processes (e.g., rainfall/runoff, stage/discharge, flow, velocity). These "hydro" processes are also fundamental to methodologies used in the navigation and flood risk reduction missions of the COE. The hydro processes utilize an enterprise suite of models in daily operations. These same models can be used to provide inputs to ecological models for simulation of ecological response to changes in flow and implementation of restoration features such as islands, and floodplain connectivity. This approach can be characterized with 3 "genre" of coupled eco-hydro models, 1) habitat suitability models and index models with hydrologic models (e.g. general hydrographs), 2) habitat suitability models and index models with specific hydrodynamic models (e.g., velocity, shear stress), and 3) bioenergetics, individual-based, population models with hydrodynamic models that include water quality. Examples of these approaches being used in the Upper and Lower Mississippi River and Chesapeake Bay will be presented.

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Incorporating Decision Analysis and Predictive Design into Stream Restoration: The Stream Project

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We present the framework of a stream restoration decision analysis and design guidance product that defines and implements a rational, objectives-driven approach to evaluating and designing stream restoration projects. The Stream Project is a collaboration among scientists, engineers, and decision analysts at the National Center for Earth-surface Dynamics (NCED), the Intermountain Center for River Rehabilitation and Restoration (ICRRR) and the US Army Corps of Engineers (USACE).

Two key challenges define the intent of the Stream Project and its contribution to the existing practice of stream restoration. The first is an essential and pervasive interaction among science, engineering, decision analysis, and practice. None of these perspectives are sufficient on their own but must be explicitly combined to develop a framework that supports project assessment and design decisions. The second key challenge is to develop an approach that is both objectives-driven and predictive. Our goal is a well-defined and transparent methodology in which specific, quantifiable objectives are explicitly linked to design choices. Additionally, the framework will quantify benefits and costs, allowing the user to evaluate tradeoffs, and support the development of adaptive restoration program management. This presentation will present the Stream Project structure and describe the decision and design tools used.

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Thinking Ahead: Incorporating Climate Change into Aquatic Ecosystem Restoration Planning for the Ala Wai Watershed Project

Cindy S. Barger

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The Ala Wai Watershed Project is a multi-purpose flood risk management and aquatic ecosystem restoration project sponsored by the U.S. Army Corps of Engineers, Honolulu District, the State of Hawaii Department of Land and Natural Resources, and the City and County of Honolulu Department of Environmental Services. Encompassing approximately 19 square miles on the island of Oahu, the Ala Wai Watershed has more than 160,000 residents and is part of the most densely urbanized metropolis in the United States. In addition to a variety of residential, commercial, and institutional development, the watershed also includes Waikiki, a prime tourist destination that attracts more than 72,000 visitors per day and generates approximately 11% of all civilian jobs and 12% of the tax revenues for the State. A large portion of the watershed, including Waikiki, is highly susceptible to flooding. Development has significantly decreased aquatic ecosystem structure and function, resulting in a steady decline of habitat for endemic species. Urban uses and activities have further exacerbated ecosystem degradation through loading of sediment and pollutants, resulting in the inclusion of the Ala Wai Canal and its tributaries on the U.S. Environmental Protection Agency (EPA) Clean Water Act §303(d) List of Impaired Waters. In addition, Hawaii as a whole is susceptible to major physical changes as a result of global climate change. Anticipated physical changes in Hawaii include sea level rise, which is likely to inundate the majority of Waikiki, reduction in groundwater recharge associated with hydrologic shifts, increased advancement of invasive species associated with changes in temperature and rainfall frequencies and intensities, and population growth associated with increased immigration of “climate change refugees” from other low-lying Pacific islands.

A consolidated understanding of how to incorporate resiliency to climate change into any aquatic ecosystem restoration activity would add to the potential success of the project to withstand the variety of pressures that lie ahead. In association with this project a literature review was conducted to identify recommended planning strategies to address climate change for watershed-based aquatic ecosystem restoration, primarily in the United States. Six common themes arose during the review: understanding the local impacts and interactions of climate change; acknowledging the uncertainties in restoration ecology today and climate change predictions for the future; letting go of goals of restoring to historic conditions or points in time; committing to long term monitoring to support adaptive management goals and ensure success; realizing that “one size does not fit all” – multiple solutions will be necessary to address the multiple interactions associated with climate change; and planning for surprises through adaptive management. The Ala Wai Watershed Project framework was evaluated against these themes to identify potential opportunities and constraints to incorporating climate change adaptation strategies into the restoration framework.

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Downscaled Regional Climate Models and Future Chesapeake Bay Loads

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The regional commitment to a Bay-wide TMDL requires substantial implementation of management actions throughout the Chesapeake watershed, from New York to Virginia. The TMDL estimates have been derived from a coupled watershed model (HSPF) and a hydrodynamic-water quality model (CH3D-ICM) with each state/jurisdiction in the basin assigned limits to loads for nutrients and sediments. The Chesapeake Bay Program Scientific and Technical Advisory Committee, Pennsylvania State University, U.S. EPA, and U.S. Geological Survey agreed to explore possible changes in loads expected under future climate that has been predicted by the IPCC for the region. To assess climate change impacts, we conducted six 10-year simulations of the coupled watershed model for the last decade of the 21st century, in which mean annual cycles in air temperature and precipitation forcing were altered according to the projections of six GCMs using the A2 SRES scenario. On the Bay-wide basis, all six GCMs showed warming in every season and annually, while projected precipitation changes varied considerably in sign and magnitude. Simulated stream flow decreased in all seasons for all but one model run, which showed a slight flow increase in the winter. Annually, all six model runs produced a substantial decrease in stream flow, with the mean anomaly of -0.18 m yr^{-1} relative to a historic baseline of 0.5 m yr^{-1} . This decrease in stream flow can be largely attributed to warmer air temperatures, rather than to precipitation changes. Anomalies in simulated nitrogen, phosphorus, and sediment fluxes did not show a consistent pattern among the six model runs and did not mimic the stream flow. Seasonal and annual changes were on the order of $\pm 25\%$ for nitrogen, $\pm 50\%$ for phosphorus, and $\pm 100\%$ for sediment. Averaged over the six runs, annual anomalies were negative for nitrogen and phosphorus, and close to zero for total suspended solids. These results will be discussed relative to future regional land use changes, acknowledging constraints embedded in the use of evenly distributed rainfall in the scenario runs and in the application of the HSPF model.

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Balancing Urban Growth and Sustaining Valued Eelgrass Habitat: Monitoring to Meet Future Restoration Goals on Cape Cod, MA

Pamela Neubert – presented by ***Kathryn S. Barnicle***

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Anthropogenic disturbance from increased summer and year-round Cape Cod population to its coastal habitats has consequently led to ubiquitous degradation. Finding the fine line between preserving Cape Cod's prized coastal habitats and maintaining economic growth is no simple task. AECOM teamed with Town of Falmouth (Town) to perform eelgrass and shellfish habitat assessments of three coastal pond systems to provide scientific information, public outreach, and geographic information system (GIS)-based databases that will allow the Town to make management decisions including: development of harbor management plans, shellfish seeding, sewerage projects, and eelgrass restoration/recovery. Over 500 acres of habitat were studied as part of the Town funded program. Results from Green Pond, West Falmouth Harbor, and Childs and Eel River provide a comparison to discuss strategies for managing three different ecosystems within the jurisdiction of one Town. The data for each of the three coastal ponds is currently available to the public through the Town of Falmouth GIS department. By combining information from the assessment work with resulting GIS-databases has given the Town information to develop a draft management plan for Green Pond and a flexible management tool to assist with understanding coastal habitat dynamics and meeting future restoration goals throughout the Town of Falmouth.

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Ups and Downs of a Salt Marsh Restoration Project in an Urban Setting

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As mitigation for construction of a commercial development in a setting where salt marsh was historically filled, a confidential client proposed salt marsh restoration in situ. The filled salt marsh was located in a highly urbanized setting north of Boston in an area where salt marshes had been systematically filled by construction debris over a period of 20 to 50 years based on forensic research performed by the consultant including aerial photographs and various maps. Hurdles encountered during this project included the type of urban fill found, coordination between local, state, and federal agencies, interpretation of regulatory fill and dredge definitions, and environmental unknowns. This talk will summarize the good and bad, the ups and downs, of the entire process from start to finish including lessons learned. Most beneficial was the ability of the regulatory agencies to allow for flexibility of design changes when hurdles were encountered, pro-active action items when successes were not achieved as expected, and (almost) successful conclusion of the project.

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Towards Effective Adaptive Management on the Upper Mississippi River System

Charles P. Spitzack and **Kenneth A. Barr**

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The Upper Mississippi River and Illinois Waterway Navigation and Ecosystem Restoration Program (NESP) was authorized in WRDA 2007 for the dual purpose operation and maintenance of the system for Navigation and the Environment. Title VIII of WRDA 2007 authorizes navigation efficiency measures including new locks and ecosystem restoration measures intended to offset ongoing cumulative effects to the system. It is the vision of Upper Mississippi River stake holders “to seek long-term sustainability of the economic uses and ecological integrity of the Upper Mississippi River System” with a goal “to conserve, restore and maintain the ecological structure and function of the Upper Mississippi River System”. The authorization calls for a robust adaptive management approach including an Advisory Panel of representatives from federal and state government and non-government organizations.

The Upper Mississippi River System will be presented as a 25-year case study toward implementing effective adaptive management in support of restoring and sustaining a national significant ecosystem to meet multiple needs. The presentation will discuss challenges and successes related to addressing:

- Human dimensions of stakeholder collaboration
- Governance toward common goals
- Institutional culture including evolving policy and guidance
- Embracing uncertainty in managing risk
- Decision making and resolution of competing objectives

The brief overview is intended as backdrop to a facilitated discussion on overcoming institutional barriers for implementation of an effective Adaptive Management Program.

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Observations of the Temporal and Spatial Distribution of Hurricane-induced Land Loss in Coastal Louisiana over the Past 60 Years

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A combination of historical aerial photography and Landsat Thematic Mapper (TM) satellite imagery were used to identify hurricane-induced land loss in coastal Louisiana marshes from the 1940s through present in coastal Louisiana. Historical hurricane magnitude, track, and landfall information, obtained from the National Oceanic and Atmospheric Administration, were used to identify candidate storms. Landfall bracketing TM imagery and photography were then compared to identify probable storm-formed or storm-expanded water bodies. Most observed loss was related to the removal or partial removal of marsh vegetation by storm surge or to shoreline erosion caused by enhanced wave action. The TM imagery was used to identify loss caused by Hurricanes Andrew (Aug. 26, 1992), Lili (Oct. 3, 2002), Ivan (Sept. 16, 2004), Katrina (Aug. 29, 2005), Rita (Sept. 4, 2005) Gustav (Sept. 1, 2008), Ike (Sept. 13, 2008), and Tropical Storm Isadore (Sept. 26, 2002). The same techniques were applied to historical aerial photography to identify land loss caused by Hurricanes Audrey (Jun 27, 1957), Hilda (Oct. 4, 1964), and Betsy (Sept. 9, 1965).

Detectable hurricane-induced land loss increased with storm magnitude. Hurricane Audrey, a category 4 storm that made landfall at Cameron Louisiana, caused land loss 350 km east to the Mississippi River. Category 2 or lesser storms caused detectable localized loss within 100 km east of landfall. Land loss magnitude and spatial distribution was greatest immediately east of storm landfall and then decreased eastward. Storm-induced land-loss decreased immediately to the west of storm landfall implying most identifiable land loss was caused by storm surge rather than wind. Consecutive storm landfalls caused commingled land loss patterns of varying magnitude and spatial distributions consisting of new ponds and expanded ponds, some of which have remained in place for over 60 years.

These observations suggest that hurricanes have and will continue to contribute to land loss in coastal Louisiana. Hurricane surges sculpt the coastal landscape. The decadal and greater sampling periods used to measure historical land loss lack the temporal resolution to identify hurricane surge-induced loss or to correlate loss with individual storms. Identifying past storm-induced loss may lead to enhanced coastal restoration strategies and improved coastal landscape projections.

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Protecting the Chesapeake Bay: Voluntary Projects on Private Lands

Josiane Bonneau, Katherine A. Basiotis, Jeffrey Popp and Douglas R. Stephens

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In the United States approximately 75% of the land is privately owned which makes conservation activities on non-government land crucial to creating suitable environmental conditions to support habitat and biodiversity on local and regional scales. The Wildlife Action Plans of all six states in the Chesapeake Bay watershed recognize this and all include private landowner engagement as a goal or conservation action. The Wildlife Habitat Council assists private land owners to enhance and restore wildlife habitat. Wildlife habitat projects on private land not only provide wildlife habitat but also can reduce erosion and reduce polluted runoff, which are major issues within the Chesapeake Bay watershed.

The presentation will highlight case studies of three successful projects to protect and restore the Chesapeake Bay watershed: rain gardens, grassland management, and stream restoration. These efforts are carried out on sites ranging from corporate campuses to county landfills to retirement communities, demonstrating that there is widespread opportunity for private landowners to participate in restoration projects. These projects also provide hands-on educational opportunities for learners of all ages. The case studies will provide details on planning the projects, technical resources, the environmental benefits, and community benefits of the projects. Taken as a whole, projects such as these can have a significant cumulative positive effect on the Chesapeake Bay and its watershed.

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***Jatropha curcas* L. for Degraded Lands' Restoration and Greenhouse Gases' Emission Mitigation**

Getulio T. Batista and *Willian J. Ferreira*

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The use of renewable energy, as substitute of petroleum, has been highlighted throughout the world. In this sense, and in order to minimize environmental impacts biofuels are emerging as a sustainable source of energy. *Jatropha* (*Jatropha curcas* L.) appears in several countries as an important feedstock option for biodiesel production, especially in degraded soils of low fertility, as it is expected that it helps to improve the physical characteristics of such soils and mitigate greenhouse gases' emissions. However, the lack of research to improve the productivity obtained in the initial years of planting, when the production is not stabilized yet, has impaired farmers and investors interest in increasing planted areas. Thus in this paper, the environmental benefits were weighted against some obstacles that have hindered the sustainability of *Jatropha* in Brazil.

The environmental benefits are important attributes in the process of sustainability. Studies of soil condition with *Jatropha* in the Paraíba Valley, SP, even in a short time, demonstrated the improvement on soil water infiltration capacity, reducing runoff and erosion in these areas. The fixation of CO₂ of a *Jatropha* tree with 4 years of age is 8 kg / year, on average. In addition, there is the contribution that will result from the combustion of biofuel in replacement of fossil diesel. Social gains are also expected considering that production is linked to family farms.

This species has been cultivated for little over seven years and plantations are found in all regions of the country. Currently, research efforts are aimed to identify plants that have uniform flowering, produce prematurely, have high oil content seeds, yield at least 1200 kg / ha in semi-arid regions, with resistance to diseases, pests and have strong stems, for possible mechanical harvesting. This crop has not shown the expected productivity so far, however, there are 30,000 hectares planted in the country, which evidence the need for research throughout the entire production chain, as well as the need for evaluation of the entire life cycle of biodiesel from *Jatropha curcas*.

Even with setbacks on the benefits of biodiesel, recently, the aviation industry established partnerships with major manufacturers and promoted test flights with a new derived product from *Jatropha*, the bio-jet fuels. As results, significant reduction, up to 80%, in emission of pollutants on the fuel currently used was achieved.

Despite the remaining uncertainties, there is great interest in *Jatropha* in various sectors in Brazil. In order to overcome these barriers and capitalizing on the environmental benefits, it is recommended the intensification of research and the establishment of policies and mechanisms for production and sustainable use of biodiesel.

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Remote Sensing Tools for Restoration: A Case Study of a Median Size Hydrographic Basin in Brazil

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The management of land use is decisive in the characterization of impacts that occur over water bodies as well as in the magnitude of the transfer processes between internal and external interfaces to a watershed. Industrial growth and the anthropocentric view in detriment to the conservation of natural resources led to a profound transformation of the earth's surface. The importance of the Una River basin, the object of the study reported here, in the context of the large basin of Paraíba do Sul in southeastern Brazil, became clear in the analysis of the Paraíba do Sul Watershed Committee (CBH-PS). The rate of urbanization of the watershed, the degree of degradation, the existence of conflict over water use determined a high priority for investment of resources distributed by this Committee.

The generation of detailed knowledge about the processes that affect water quality in a watershed requires the existence of a wide range of information produced by frequent monitoring of changes in land use. This information allows the construction of current and future scenarios that include the impacts of conservation and restoration actions in selected areas. Therefore, it is necessary to obtain solid data about the processes of past and future changes. Thus, remote sensing is presented as an essential and timely tool to accomplish this task. This project involved the structuring and provision of an environmental database containing information about the physical environment, land use and water resources in the Una River basin in southeastern Brazil. A geospatial database was implemented with information necessary to support actions to reduce sedimentation of the Una River and improve the quality and quantity of water in the basin. Tasks involved an aerial survey at 1:30,000 scale and the generation of orthophotos at scale 1:10,000, land use and land cover mapping of areas protected by Brazilian law, the analysis of land vulnerability, and field surveys to collect data on land use and water resources. All results were made available on the Web (www.agro.unitau.br/una).

This database allows to establish criteria for the application of modeling tools in a medium sized basin and it is warehoused at the LAGEO Laboratory in the Department of Agricultural Sciences, University of Taubaté (UNITAU). It has allowed the planning of restoration interventions that in the near future could reverse the high rate of environmental degradation that now prevails in the Una basin. The implementation of research with the involvement of undergraduate and postgraduate studies in the project have contributed to the Graduate Program in Environmental Sciences of UNITAU and the activities of the Institute of Environmental Research in Hydrographic Basins (IPABHi).

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How Not to Become Roadkill on the Road to Restoration When Transitioning from Voluntary/Consensus-Based to More Mandatory/Regulatory Approaches

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Over the course of its now 27 year history as a state-federal partnership-driven restoration effort, the Chesapeake Bay Program hit the point in its evolution where hard, life-altering choices needed to be made. Long viewed as a partnership, built on scientific understanding, consensus decision-making, and voluntary actions, the partners faced a series of choices in drafting the Chesapeake 2000 Agreement knowing a regulatory TMDL was a likely in the decade ahead.

Using specific examples, the following evolutions within the Chesapeake Bay Program partnership are traced over time:

- Restoration goals becoming more quantitative and more sophisticated.
- Accountability rising to the forefront and becoming more encompassing.
- Shared, consensus-based decision making becoming more difficult as the stakes got higher.
- Growing importance of solid scientific foundation, backed by independent peer review.
- Involvement of ever widening circle of partners and stakeholders in the decision making process.
- Increasing struggle with adopting a truly adaptive management approach to restoration decision making.

Looking ahead, there are new demands, challenges, and opportunities:

- Heightened accountability for management actions foremost in the near term.
- Increased emphasis on evaluating management effectiveness through monitoring assessment.
- Taking Bay restoration to the most local scales.
- Preaching and reaching consensus while some partners tell other partners what they can and can't do.

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Putting the 17 Million Chesapeake Bay Watershed Residents on a Regulatory Pollution Diet

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Against the backdrop of over 45,000 TMDLs approved by EPA nationwide over the past two decades, the six watershed states, the District of Columbia, and EPA have developed a historic and comprehensive “pollution diet” with rigorous accountability measures to initiate sweeping actions to restore clean water in the Chesapeake Bay and the region’s streams, creeks and rivers. Despite extensive restoration efforts and significant pollution reductions during the past 25 years, the TMDL was prompted by insufficient progress and continued poor water quality in Chesapeake Bay and its tidal tributaries.

Since nitrogen and phosphorus loadings from all parts of the Bay watershed have an impact on the impaired tidal segments of the Bay and its rivers, it was necessary for EPA to allocate the nitrogen and phosphorus loadings in an equitable manner to the states and basins. EPA used three basic guides to divide these loads: 1) allocated loads should protect living resources of the Bay and its tidal tributaries and should result in all segments of the Bay mainstem, tidal tributaries and embayments meeting water quality standards; 2) tributary basins that contribute the most to the Bay water quality problems must do the most to resolve those problems (on a pound-per-pound basis); and 3) all tracked and reported reductions in nitrogen, phosphorus and sediment loads are credited toward achieving final assigned loads.

The Chesapeake Bay TMDL was designed to ensure that all pollution control measures needed to fully restore the Bay and its tidal rivers are in place by 2025, with at least 60 percent of the actions completed by 2017. The TMDL is supported by rigorous accountability measures to ensure cleanup commitments are met, including short-and long-term benchmarks, a tracking and accounting system for jurisdiction activities, and federal contingency actions that can be employed if necessary to spur progress. Watershed Implementation Plans, which detail how and when the six Bay states and the District of Columbia will meet pollution allocations, played a central role in shaping the TMDL.

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Successful Specification Development and Execution: Redefining the Aesthetic Appeal of Landscape Scale Restoration Efforts

Doug Bauer

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As restoration efforts become more and more visible to the general public, it has become readily apparent that a divergence has occurred between the federal, state & local agencies who procure restoration services and the public who consumes it. Often times this can be attributed to one of two situations: a perspective variance between scientifically effective but aesthetically displeasing and a complete failure advertised as a “natural area”. This reality is compounded by uneven development of specifications across multiple agencies.

What has developed in this flawed environment is a number of economic incentives that drive contractors towards a highly modified view of ecological restoration. A view that is more aligned with risk management and profiteering than successful landscape scale restoration. Examples include the all too common specification that prescribes specific treatments as opposed to setting a performance criteria upfront and allowing a contractor to figure out how to achieve the agreed upon goal.

As part of the dialog, a detailed analysis of multiple projects, each involving interagency cooperation, will be discussed. These projects demonstrate the importance of closing the loop between implementation specialists and the design/contract management professionals tasked with conceptualizing, initiating and delivering projects on time and under budget.

Case studies to be discussed:

National Great Rivers Research & Education Center: NGRREC installed a completely sustainable (native) landscape that requires no irrigation and affords educators based at the facility easy access to the entire spectrum of local ecotypes.

Lewis & Clark Community College: Native Learning Landscapes Laboratory- LCC has driven towards a more sustainable landscape with reduced irrigation and fertilization while recognizing operational savings.

Orland Park Grasslands: USACE & Forest Preserve District of Cook County- Over 900+ acres of contiguous, urban grassland entering year 3 of a 5 year comprehensive restoration effort.

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Chattahoochee River Dam Removal and Ecosystem Restoration Project: Meeting Ecosystem Restoration and Recreation Goals

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The Mobile District U.S. Army Corps of Engineers, in conjunction with stakeholders in Columbus, Georgia and Phenix City, Alabama, are proceeding with the implementation of the Chattahoochee River dam removal and ecosystem restoration project. This aquatic ecosystem restoration project involves the removal of the Eagle and Phenix Dam and City Mills Dam at Columbus, Georgia, and Phenix City, Alabama. Based on the environmental assessment completed in 2004, the recommended alternative for this project included the breaching of both dams and the construction of a series of environmental, recreation, safety, and aesthetic features. The overall goal of the project is to restore riverine and shoal habitat on the fall line reach of the Chattahoochee River from directly below North Highlands Dam (a Georgia Power Company operated hydroelectric facility) downstream to backwater sections of Walter F. George Lake. Design of the dam removal and riverine habitat restoration has been integrated with the development of the proposed recreational features to meet all of the local project objectives.

The restoration design included an iterative process of one (HEC RAS) and two dimensional (MIKE 21) hydrologic modeling to help evaluate whether the proposed in-stream structures and excavations would meet the ecosystem restoration requirements and provide a high quality whitewater boating venue. In each phase of the project design - conceptual, 50 percent, and final design – in-stream elements were identified and designed; hydrologic modeling completed, and updated cost estimates were prepared to ensure that overall project objectives were met and that the project could be completed within the available federal and local funding limits. Hydrologic modeling was a critical component of the process due to the challenging riverine conditions and multiple project objectives. Stream flows in this reach of the Chattahoochee River vary daily due to upstream hydropower generation ranging from 800 to 13,000 cfs and seasonal high flows typically exceed 50,000 cfs. Results of the MIKE 21 2-d modeling provided information on water surface elevation, depth, velocity and shear stress that was used to evaluate critical conditions at key locations within the 2.3 mile area for restoration. This information was used to determine where there may be issues with fish stranding or passage, potential for hydraulic jumps that may be undesirable for boaters, and potential impacts on existing infrastructure. In addition, the 2-d modeling was used to evaluate flow conditions during construction to clarify construction sequencing for potential contractors which may affect construction costs by minimizing risks for the contractor and owner. Ultimately, this iterative design process defined an overall project that met both the aquatic ecosystem restoration goals and the local communities' goals for whitewater recreation.

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Managing Invasive Plant Species in the Picayune Strand Restoration Project, Southwest Florida

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In June 2009, Corps Headquarters issued a Civil Works Memorandum establishing a nationwide invasive species policy complimenting the National Invasive Species Act. The Picayune Strand Restoration Project (PSRP) is implementing this policy through the creation and implementation of a Vegetation Management Plan focusing on the control of invasive, nuisance and exotic plants.

PSRP is a leading project within the Comprehensive Everglades Restoration Plan. The project is deconstructing the infrastructure of a failed residential subdivision by filling drainage canals and removing an extensive grid of roads to restore hydrological function to over 55,000 acres of wetlands in the Big Cypress ecosystem in southwest Florida. Prior to development during the 1960's, Picayune Strand was dominated by cypress forest and associated plant communities. Currently, many of the wetland plant communities have transitioned to an upland forest frequently dominated by sabal palm, a native species now occurring in unnaturally high densities, with a sub-canopy of Brazilian pepper, a highly invasive, exotic shrub.

One of the primary project objectives is the reestablishment of natural plant community distribution and composition. To achieve this objective, nuisance and exotic plant control is essential. A special team was organized with experts from several Federal and state agencies to create a vegetation management plan consisting of two parts: exotic plant control in the deconstruction (canal filling and road removal) footprints, and exotic plant control in the remainder of the project area in the Picayune Strand State Forest. Federal and state agencies are cooperating to implement the vegetation management plan; however, full, long-term funding of the vegetation management plan is uncertain.

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Puget Sound Nearshore Ecosystem Restoration Project: Defining Restoration Vision and Measuring Success

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The Puget Sound Nearshore Ecosystem Restoration Project (Nearshore Study) is a complex, large-scale ecosystem restoration project underway for Washington State's Puget Sound Basin. This General Investigation (GI) is being completed by U.S. Army Corps of Engineers and local sponsor, Washington Department of Fish and Wildlife. The Nearshore Study will result in a portfolio of restoration projects; these projects will be designed and implemented through partnerships with the Corps and state agencies, as well as tribal governments, local governments and conservation groups, and regional/national non-governmental organizations.

Puget Sound has been severely degraded by an array of anthropogenic stressors operating across a wide range of spatial scales. Sustainable nearshore restoration can best be achieved by reestablishing or significantly improving ecosystem processes — the interactions among physical, chemical and biological elements of an ecosystem. Ecosystem processes operate at various spatial and temporal scales that are controlled or constrained by various natural and human-driven factors. Discrete spatial units such as littoral drift cells and estuarine deltas form and maintain ecosystem structure through processes, including sediment delivery and transport, tidal and fluvial hydrology, which in turn provides valued functions such as habitat for fish, wildlife and plants. Sustainable process-based restoration is the fundamental goal of Nearshore Restoration Project. The portfolio of projects selected for implementation will be evaluated in terms of full or partial process-based restoration, along with their ability to meet other project objectives. Strategies for implementing specific restoration approaches for the Nearshore Study have been critical in identifying potential solutions. Ecosystem output metrics are used to compare process, structure and function benefits in the assessment of alternatives. Given this emphasis on process-based restoration, much effort has been focused on communicating the importance of this approach to project proponents. As a result, Nearshore Study results are also being used beyond the GI to help inform the broad spectrum of on-going nearshore restoration and protection efforts throughout Puget Sound. Insuring large scale federally funded actions are working in synchrony with local and regional actions, is anticipated to yield greater cumulative efficiency, and ultimately an improved condition for Puget Sound's physical and biological resources. In addition to the portfolio of projects implemented by the Nearshore Restoration Project, moving the Puget Sound restoration community towards a strategic and process-based approach to restoration is essential to the success of Puget Sound Nearshore ecosystem recovery.

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A Company Perspective on Cooperative Assessment and Restoration: A Case Example from a CERCLA Site

Ralph G. Stahl, Jr.¹ - presented by **Bruce Bayne**

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There continue to be substantive discussions on the benefits of undertaking cooperative assessments and any subsequent restoration, from both the PRP and the trustee perspective. We report on a case where assessment and restoration were undertaken and completed in a cooperative approach at a CERCLA site in Delaware. After the RI/FS was completed state and federal trustees worked closely with DuPont and US EPA Region III to design a remedy for freshwater wetlands and a river segment contaminated with metals. After the ROD was published, remedial actions were selected that ultimately provided service flows above and beyond those that would have been provided under the ROD as originally envisioned. These actions also resulted in final clean up levels in sediments that were approximately 50% lower than those specified in the ROD. In this case, the remedial costs for this increased level of clean up did not increase over those that would have arisen under the original ROD, and in some cases were reduced. The compensatory restoration identified for this case was also done cooperatively and implementation of the project was undertaken by US FWS. Restoration was completed on time and on budget. A similar approach is ongoing at another site and this too will be discussed in this presentation.

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Accessing Biophysical Signatures in Remote Sensing Data to Inform Eco-hydromorphic Characterization of the Louisiana Coastal Landscape

Nadine C. Trahan¹ and Brady R. Couvillion² – presented by **Holly Beck**²

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Following Hurricane Katrina, the Coastal Protection and Restoration Authority (CPRA) was created to integrate discrete flood control and wetland restoration activities into a long term comprehensive coastal protection and restoration plan. In an effort to support prioritization and sequencing of restoration and protection projects, the 2012 update of Louisiana's Comprehensive Master Plan for a Sustainable Coast will include a coast-wide implementation of the Integrated Ecosystem Restoration and Hurricane Protection Project Prioritization Tool. The models used to support this prioritization tool are based upon an eco-hydromorphic approach, whereby interrelated ecological, hydrological and geomorphological form/process associations are explicitly recognized. This region comprises a deltaic landscape shaped by a distinctive set of eco-hydromorphic processes, which were initiated and continue to be maintained by complex sediment, water and vegetation dynamics arising from the meeting of the Mississippi River and the Gulf of Mexico. Eco-hydromorphic characterization of the Louisiana coastal region will foster understandings of how climate change, sea level rise, hurricanes, flooding, subsidence, vegetation distribution and accretion affect and respond to landscape change.

Various types of remotely sensed data are able to detect many of these form/process associations via radiometric reflection and absorption patterns distinctly associated with specific features and textures across landscapes. This work aims to describe the biophysical structure and dominant processes of the Louisiana coastal landscape as derived from various sources and analyses of remotely sensed data. Each remote sensor, data product and analysis method provides distinctive capabilities for detecting certain sets of landscape characteristics. Utilization of multiple sensors, datasets and methods can thus achieve an integration of the landscape being described in order to appraise interrelated and cross-scalar processes. Remote Sensing applications must consider various factors such as sensor and data parameters as well as data processing, representation, interpretation and analysis techniques. While research and management objectives play a role in matching each of these factors to an application, the landscape itself provides the fundamental context within which they must be considered. Sources of remotely sensed data include optical imagery, Lidar and Radar sensors. Resulting datasets include a complete topographic-bathymetric raster, multi-temporal estimates of water level, spatial distribution of various soil parameters, historic land change rates, and projections of future changes in landscape configuration.

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Integrated River Basin Management on the Mississippi River

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The Great Rivers Partnership (GRP) of The Nature Conservancy is uniquely positioned to consider the ecological and policy needs of the entire Mississippi River, Mississippi Delta and the Northern Gulf Coast due to broad consideration for conservation of biodiversity, systemic geographic scope and flexibility to approach issues without government constraints. The GRP recognizes that Integrated River Basin Management, or the consideration of all the multiple uses within the Mississippi River basin including; agricultural productivity, a viable and efficient inland waterway system, flood security, and recreational pursuits while maintaining a functioning ecosystem, must be factors of a sustainable the river system. A basis principle of GRP is to bring together diverse partners and the best science to begin to integrate the river uses for improvement of the economy, human well-being and ecosystem health. As a significant step forward in this principle the GRP is involved in the Mississippi River basin vision process; including conducting stakeholder surveys, supporting America's Inner Coast Summit, and providing post summit leadership to create a long term vision that will guide sustainable management of the Mississippi River.

On-the-ground or "proof-of-concept" projects pursued primarily by partnerships established by State Chapters of The Nature Conservancy and state and federal agencies provide a backbone of knowledge through implementation of processes or construction of projects that restore thousands of acres. These projects are important because they add to restoration knowledge, inform large efforts on how to be effective, create or expand partnerships for conservation work, provides innovative solutions to current problems, and communicate restoration possibilities with other rivers. Leveraging this important body of work to regional and national scales including policy development and refinement is an essential focus of GRP. Working with numerous partners this work has helped to move tributary watershed partnership projects into the 12 state Mississippi River Basin Initiative (MRBI), inform floodplain restoration work, and help to inform efforts to include ecosystem needs with needs of flood control and navigation in the lower 954 miles of the Mississippi River.

Legislation, funding, policy refinement, and program guidance are but a few of the tools necessary for successfully moving to Integrated River Basin Management. Working with numerous partners we identify what the issues are, how to solve challenges and then work for changes necessary to eliminate these impediments in the efforts to achieve a sustainable Mississippi River. Our work supports mature partnerships that work on policy issues and provides leadership to fledging partnerships that will thrive with support.

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Prioritizing Watershed Restoration: Headwater versus Downstream Projects

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Significant efforts are invested in identifying, prioritizing and selecting restoration projects for implementation. Implementation funds are always in shorter supply than restoration projects. Selecting the 'best' restoration projects for implementation is an iterative process. Many local watershed or government entities (e.g., Township, County) select one or more projects to put forward for grant funding, the granting agency looks at many applications and selects the most promising projects to fund, and the selected projects are implemented. The criteria for identifying and selecting the 'best' restoration projects are varied, perhaps the largest area per unit cost, a suite of water quality benefits, etc.. Most often, the source control projects are not scored highly because their unit costs are high and the project area is usually limited.

This presentation focuses on a watershed restoration plan, two alternative restoration projects, and a more complicated but still simple evaluation of cost-benefit analysis. The most highly recommended restoration project involved the modification of ~9.4 acres of forested floodplain to retain ~38,000 CY of storm water runoff for a cost of \$550,000. A second restoration site which was not selected for submittal to the granting agency involved the restoration of approximately 1,100 lf of stream, the modification of 6.5 acres of forested floodplain to retain ~6,000 CY of storm water runoff, for a cost of \$450,000. The former project was estimated to deliver water quality benefits for ~14.50 per CY of water. The latter project was estimated to deliver water quality benefits for ~\$75 per CY of water. Based on this analysis, it appears clear that the former project has the 'bigger bang' and this was the basis for selecting the project.

However, going beyond this '1st cost analysis', and considering the cause and source of water quality degradation (e.g., hydro-modification and sediment supply), a different analysis yields a much different understanding. In this analysis, the former project does nothing to reduce sediment supply at the source (e.g., the eroding stream channel), but effectively interrupts the sediment supply for only ~1 1/2 to 3 1/2 years before the storm water storage volume is filled with sediment from upstream channel erosion and the project is in equilibrium with its sediment supply. This results in a total project cost of ~\$160,000 to \$440,000 per year for the life of the project. Over a 50 year project life, this project traps up to 19,000 CY of sediment at a cost of ~\$29/CY, but has lost all sediment trapping and hydro-modification capability after 1 1/2 to 3 1/2 years. Alternatively, the latter project fixes the problem at its source, eliminating between 240 CY and 622 CY of sediment per year for every year with no prospect for loss of this function and it retains a 6,000 CY storm water volume to support hydro-modification. Over a 50 year project life, this project traps eliminates 12,000 CY to 31,000 CY of sediment at a cost of \$37.50 to \$14.40 per CY with no loss in function.

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Estimating Recreational Benefits from Coastal Restoration Projects in Louisiana

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Coastal restoration projects in Louisiana will impact recreational use of its many coastal estuaries. The primary recreational uses are consumptive uses; fishing and hunting. Wildlife watching is also a significant recreational activity. Although most recreational users are from southern Louisiana, each of these activities attracts recreational users nationwide.

Three methods are approved for estimating the National Economic Development (NED) recreational benefits of federal water projects: the travel cost method, the contingent valuation method, and the unit day value method. The travel cost method and the contingent valuation method require extensive data that is not readily available for each restoration project. The unit day value method uses values and criteria established by the Corps of Engineers. These criteria include likelihood of fishing/ hunting success, travel time to obtain species sought, and esthetics. Each of the criteria are impacted by several factors. For example, the likelihood of fishing success is impacted by water turbidity and salinity. Travel time can be impacted by invasive species clogging waterways. Recreational benefits are then estimated by multiplying these values by the number of user days which are estimated based upon participation rates from the Statewide Comprehensive Outdoor Recreation Plan (SCORP) and fishing/hunting licenses issued.

To better understand factors impacting recreation, focus groups of experts were organized for several estuarine basins to elicit their opinions. These focus groups consisted of experts from non-governmental organizations, state and local government, marina owners and charter fishermen. Bringing these experts together to discuss the factors impacting recreation provided a wealth of information. One consistent finding from each focus group was that Louisiana as a sportsman's paradise is important to residents, who are aware of the need for coastal restoration projects, but their support is dependent upon their understanding of how these projects will benefit the coastal ecology.

Coastal restoration projects consist of measures, such as freshwater diversions, marsh creation, ridge stabilization, and channel closures. During plan formulation, these measures are combined into alternatives. Alternatives are then evaluated based upon environmental outputs, such as marsh creation and salinity level reductions. Recreational benefits are considered incidental to the decision making process and are not used to select an alternative. The focus groups helped to understand the relationships between coastal ecology, and recreational uses supported by the estuaries. Since recreational impacts to the coastal estuaries impact a large portion of the population, and public support is necessary to implement large coastal restoration projects, understanding the recreational impacts of coastal restoration projects is important.

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Marl Prairie Vegetation Response to 20th Century Land Use and Its Implications for Management in the Everglades

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During the 20th century, the natural hydrology of the Florida Everglades was altered by compartmentalization of the ecosystem and a range of water-management and land-use practices. Recent research indicates that sustained changes in hydroperiod played significant roles in structuring tree islands and the ridge and slough landscape. These changes resulted both from natural climate fluctuations and anthropogenic alteration of Everglades hydrology. New research examines the long-term history of marl prairie habitats of the Everglades, which provide critical refuges for rare and endemic species, including the endangered Cape Sable Seaside Sparrow (CSSS). This research is intended to document the longevity and stability of the marl prairie habitat using paleoecological proxies for vegetation and hydrology. Strategies to stabilize and maintain habitats are an important component of Everglades restoration planning.

To reconstruct the distribution of marl-prairie vegetation during the last few millennia, sediment cores were collected in the current CSSS habitat, described lithologically and samples were analyzed for geochronology, pollen, and charcoal. Additional cores were collected in areas historically occupied by the CSSS. The palynological and charcoal record from cores collected in current CSSS habitats indicates intervals of drier conditions ~400 to 500 calibrated years before present and during the 20th century. The most significant vegetation changes occurred during the 20th century, when short-hydroperiod species (Poaceae, non-*Cladium* Cyperaceae, and Asteraceae) are more abundant and charcoal concentrations are greater at nearly all sites.

The variability in vegetation and hydroperiod throughout the modern marl prairie habitat provokes questions on long-term use of the habitat by various plant and animal species. Overall, this study demonstrates that plant communities within the current marl prairie habitat have fluctuated during the last few millennia in response to both natural hydrologic variability and anthropogenic modification of the ecosystem. These results provide data on the rates and directions of response of wetland habitat to different climatic and environmental stressors. Such information is needed to improve forecasts of future wetland response to management and climate scenarios.

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Estimating the Supply of Ecosystem Services for a Carbon Resource Assessment

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Two basic ingredients are needed to understand the social cost of carbon: 1) the quantity of carbon currently being sequestered in terrestrial ecosystems under existing policies and 2) the quantity potentially being sequestered under different policies to encourage carbon storage. Linked to the supply of sequestered carbon are physical byproducts produced in the same ecosystems consequently generating externalities that, in some cases, become interregional. For example, specific management actions that incentivize carbon mitigation (specifically, increased sequestration) can be complimentary and / or competitive with other provisioning and regulating ecosystem services. The regional output of current land uses and potential new management actions supply a total expected resource value of carbon and ancillary ecosystem services. These are two necessary components in a national resource assessment.

In this paper, we develop a method for estimating the regional supply of ancillary ecosystem services for a quantity of terrestrial carbon sequestered. For example, ecosystem services such as wildlife habitat (migratory birds, amphibians), forest biomass, nitrate retention, and sediment retention introduce potential external benefits associated with the estimated regional supply of sequestered carbon. First, a regional production possibility frontier (RPPF) is estimated for specific ecosystem services in the lowlands of the Lower Mississippi Valley region. The RPPF is the total expected resource value of carbon and ancillary ecosystem services for different combinations of lands in agriculture and forest in the region. Next, from the distribution of land cover, we estimate the change in services, in response to a land use policy that creates an incentive to convert agricultural land into forest. The third step is to aggregate the quantity supplied of other services into a regional estimate for input to a landscape scale resource assessment. As part of a resource assessment, a management activity such as afforestation yields an expected quantity of carbon for an investment and operating cost and the ancillary ecosystems services affected by that activity (either positive or negative externalities or both). If the impact on the service is complimentary, it is a positive deviation from the expected value of the carbon quantity; conversely, competitive impacts are a negative deviation from the expected value.

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Toxic Chemicals and Fish Health in Chesapeake Bay

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The Chesapeake Bay Executive Order recognized that there is not currently sufficient information on which to base specific goals and strategies in regard to toxic chemicals. We can generally consider the issue of toxic chemicals in two ways. First, are the chemicals that accumulate in fillets or muscle and for which there are human health advisories. The second are the ecosystem effects, in particular those that negatively influence fish and wildlife health. Unfortunately, addressing the first does not necessarily address the second. Research and monitoring have shown that chemicals are differentially accumulated in various tissues, with muscle generally having the lowest concentrations. Significantly higher concentrations are measured in eggs, brain and tissues involved in the immune response of fishes, which may have serious consequences for health and reproduction success. To begin to address restoration for healthy/uncontaminated habitats we need to identify contaminants of concern, understand their sources and transport within the aquatic system and develop better metrics for identifying effects. Currently, there are Aquatic Toxicity Benchmarks for many of the legacy chemicals (PCBs, metals) and pesticides. However, for fishes these benchmarks are primarily based on either mortality (acute) or larval fish growth (chronic). They do not consider the effects of complex mixtures, presence of potential pathogens, concurrent parasite infections or many of the environmental stressors in the natural environment. Additionally, there are no benchmarks for many contaminants of emerging concern. Impacts of endocrine-modulating chemicals can be subtle but have significant population effects. Recent fish kills of centrarchids in the Potomac and Susquehanna rivers, a high prevalence of male bass with intersex (testicular oocytes) in both of these river systems, the high prevalence of chronic *Mycobacterial* infections in striped bass, and skin and liver tumors in bullheads, all demonstrate the need for effects-based monitoring. This presentation will synthesize some of the known impacts of toxic chemicals on selected fish species, impacts of emerging contaminants and ongoing research to identify sources and potential approaches to reduce these impacts.

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A Case Study in Interdisciplinary Collaborative Education in Ecosystem Restoration: The ERIE Practicum at the University at Buffalo

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The *Ecosystem Restoration through Interdisciplinary Exchange* (ERIE) Program at the University at Buffalo (UB) is an interdisciplinary doctoral program that advances ecosystem restoration science and engineering while contributing to the ecological recovery of the Great Lakes and western New York State. Collaborative partnerships span multiple UB academic departments and external entities to provide a novel environment for training researchers in the technical, cultural, and ethical issues of restoration practice. Training activities include interdisciplinary courses on restoration philosophy, theory, and practice; team dynamics workshops; and professional exchanges with U.S. and Canadian partners. A culminating experience of the ERIE curriculum occurs in the trainees' third semester with the "Ecosystem Restoration Practicum" course, a project-based course in which trainees from disparate disciplines (American Studies, Biology, Chemistry, Environmental Engineering, Geography, Geology, and Philosophy) collaborate with their peers and with external sponsors on a restoration project planning experience based in western New York. The ERIE Practicum experience has occurred twice with different results and environments. In the first year, six ERIE trainees partnered with public and non-profit entities to work on the restoration of the Earsing Sills Oxbow Wetland (West Seneca, NY), a riparian environment of legacy value to the heavily industrialized Buffalo River watershed, resulting in a watershed restoration and stewardship plan that secures the preservation of a regionally-rare ecotype as a natural area. In the second year, three ERIE trainees consulted to a private corporate landowner to design a phytoremediation installation for mitigation of chlorinated-solvent groundwater contamination at an unused former gravel mine site, resulting in restoration and stewardship recommendations that preserved and accentuated some of the site's industrial contamination history. For both projects, reported student evaluation of the experience shows a high level of satisfaction and personal enrichment from the interdisciplinary collaboration, and cross-disciplinary communication within the group was facilitated by the shared experience of the ERIE educational environment. Continued enhancement of this experience for subsequent trainee cohorts will produce leading scholar-practitioners in the rapidly advancing field of ecosystem restoration.

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A Modeling Framework for Evaluating Stream Restoration Techniques and Ecosystem Response

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The practice of stream restoration is still often viewed as an “art” versus a science. This view is further fueled by the manner in which many restoration projects are identified and implemented- on a case by case basis with little documentation on the drivers of the ecosystems in question or the establishment of success criteria once the project is complete. While monitoring data may exist to quantify the existing conditions of a stream (biological, chemical, and physical) prior to restoration, these data are not always easily translated into design criteria for restoration due to the dynamic nature of streams. In an attempt to address the critiques of existing stream restoration practices, a conceptual model is proposed which identifies the ecosystem drivers in a stream system at varying temporal and spatial scales based on the hierarchy of general systems. Using an energy circuit diagramming as a template for this conceptual model, a guiding image of the stream ecosystem is presented that incorporates the effects of in-stream restoration structures on the ecological functions of the stream and possible trajectories of these ecosystems with and without restoration. The energy circuit diagram is translated into a STELLA modeling framework in an attempt to quantify, the potential interactions among biological, chemical and physical structure of the stream ecosystem due to changes in energy signatures (physical, chemical and biological) as a result of stream restoration practices. Pre and post restoration scenarios in a site specific reach in Elton Creek near Delevan, New York will be presented. State variables and boundary conditions are discussed, as well as sources of data to calibrate the model. The model will be calibrated using field data from Southern Ontario Stream Monitoring and Research Team (SOSMART) database. Expected outcomes of this research are better informed stream restoration design criteria based on quantifiable ecological benefits.

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Fighting Water with Water: Counteracting the Impacts of Sea Level Rise on South Florida Waters

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Sea level rise and changes in precipitation patterns due to climate change increasingly imperil south Florida's water resources and Everglades. Water managers are faced with daunting challenges to preserve the region's water supply and ecological systems. These include: 1) maintaining adequate water supplies during periods of extended severe drought in the face of saltwater intrusion exacerbated by sea level rise, 2) preventing potentially devastating urban flooding during torrential rain events of increasing intensity when stormwater drainage systems will be compromised by sea level rise, and 3) moderating inundation of the Everglades and coastal wetlands by seawater. New approaches will be required to improve the resilience and prolong the sustainability of the region's water resources and wetlands. A number of logical, though potentially controversial alternatives will be presented to stimulate thinking about new solutions.

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Guideline for Assessing Sediment-Related Effects of Dam Removal

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Dam removal is becoming more common in the United States as dams age and environmental concerns increase. Sediment management is an important part of many dam removal projects, but there are no commonly accepted methods to assess the level of risk associated with sediment stored behind dams. To address this need, the interagency U.S. Subcommittee on Sedimentation (SOS) is sponsoring the development of a decision framework that provides guidance on evaluating sediment-related effects from dam removals. The guideline is written for a technical audience with knowledge in river hydraulics and sedimentation processes, but may also serve as a reference and communication tool for scoping discussions with resource managers, permitting staff, and stakeholders.

The decision framework provides guidance on the level of sediment data collection, analysis, and modeling needed for reservoir sediment management. The guideline can be used first as a scoping tool and second as an implementation and monitoring tool as the project proceeds forward and more information is gathered. The framework is based on criteria which scale the characteristics of the reservoir sediment to sediment characteristics of the river on which the reservoir is located. To assist with the framework development, workshops of invited technical experts from around the United States were convened October 2008 in Portland, Oregon and October 2009 in State College, Pennsylvania. The decision framework developed at these workshops is currently being validated with actual dam-removal case studies from across the United States including small, medium, and large reservoir sediment volumes. This presentation summarizes the latest thinking on key components of the guidelines. The presentation represents contributions from over 26 entities who have participated in the development of the guidelines. After completion of the case study application, the framework will be published.

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Evaluation of Hydraulic Flushing for Sediment Management at Lewis and Clark Lake: Assessing Effectiveness and Impacts using GSTARS4

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The Missouri River Mainstem Reservoir System includes six large dams, storing up to three years worth of Missouri River flow. Since the closure of these dams from 1937-1965, the sediment load delivered to the lower river has been reduced to zero. The resultant aggradation and degradation can have significant impacts on all of the authorized project purposes. An element of the 2003 Revised Biological Opinion (BiOp) by the US Fish and Wildlife Service calls on the U.S. Army Corps of Engineers (Corps) to evaluate methods to reintroduce sediments to the Missouri River, aiding in the development of habitats for threatened and endangered species. Based on earlier reconnaissance level review, sediment flushing was selected for analysis as a possible way to moved sediments below the dams.

As part of the Missouri River Recovery Program (MRRP), which is the program designed to meet the RPA's of the BiOp, the Corps worked with the Hydrosience and Training Center at Colorado State University to test the newly developed Generalized Sediment Transport model for Alluvial River Simulation version 4 (GSTARS4, Yang and Ahn 2011). This model incorporates and refines the functionality of multiple previous models and allow for effective modeling of reservoir sediment flushing scenarios. GSTARS4 can be used for steady as well as unsteady flow simulations.

The model was used to evaluate theoretical flushing scenarios in an attempt to determine the effectiveness and impacts of various flows and durations. The model was applied to the reach of the Missouri River from Fort Randall Dam to Gavins Point Dam near Yankton, SD. GSTARS4 simulation results show that various flow conditions can move significant amount of sediment through the dam spillway and temporarily reduce the impact of aggradation within the study reach. Transport of sediment also aids downstream reaches that are sediment starved and supports habitat creation/diversification for many species. The model output provides detailed information on total suspended load and particle size distribution coupled with discharge. The GSTARS4 model can be used for steady and unsteady flow simulations to determine stage and aggradation/degradation impacts for the 70 mile study reach and the reach below the dam. The impacts of the modeled flushing on downstream habitats will be discussed.

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Supporting Chesapeake Bay Restoration by Modeling Nutrient and Sediment Sources and Transport

John W. Brakebill, Scott W. Ator and Joel D. Blomquist

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Water quality in Chesapeake Bay, the largest estuary in North America, has been degraded due to excessive nutrients and sediment. The U.S. Geological Survey (USGS) supports Chesapeake Bay resource managers and restoration efforts through research and modeling of the upland sources of nutrients and suspended sediment and the factors that affect transport of these compounds from the watershed to the bay. SPATIALLY REFERENCED REGRESSIONS ON WATERSHED attributes (SPARROW) are models that have been calibrated to quantify sources, fate and transport factors significant to the occurrence of nitrogen, phosphorus, and suspended sediment. SPARROW uses a hybrid statistical and process-based approach to relate observed in-stream fluxes to contaminant sources and physical factors that affect fate and transport. Such relations support spatially explicit predictions of nutrient and suspended-sediment fluxes and yields from individual sources (such as atmospheric deposition, point-source discharges, different land uses, stream channels, and commercial fertilizer and manure applications) and the physical factors that affect their transport to streams and the Bay. These evaluations are directly applicable to the management of nutrients and sediment in watersheds of estuaries like the Chesapeake Bay. SPARROW results have previously been used by the USDA to target areas for improved agricultural practices. Applications and results from enhanced spatial resolutions of these SPARROW models can be a beneficial tool to help other federal, state, and local agencies prioritize practices designed to further reduce sediment and nutrients from a variety of sources and settings.

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Grover's Mill Pond Restoration: Habitat Improvement and Beneficial Use of Dredged Material

Heather N. Jensen and Gregory A. Wacik – presented by **Beth Brandeth**

U.S. Army Corps of Engineers, Philadelphia District, Philadelphia, PA, USA

The primary goal of the Grover's Mill Pond Restoration Project was to restore fisheries habitat in this degraded 37-acre freshwater pond. This was accomplished through a combination of sediment removal from the existing pond bottom, physical habitat improvements, and state re-stocking efforts. In addition, the material dredged from the pond was beneficially used to create a recreation field in an adjacent park. The project was authorized under the Water Resources Development Act of 1996, Section 206, Aquatic Restoration, as part of the Continuing Authorities Program.

Grover's Mill Pond was made famous by its mention in the 1938 "War of the Worlds" radio broadcast. It is located on Big Bear Creek in West Windsor Township, Mercer County, NJ.

Over the years the pond has exhibited eutrophic tendencies, excessive aquatic plant growth and had silted to the point where the average water depth was between one and four feet. The nutrient-rich silt created anoxic conditions and excess aquatic plant growth. There was little refuge habitat for local fishery populations due to the shallow water depth, high water temperatures during the summer, and the ice and colder water temperatures during the winter.

Approximately 65,000 cubic yards of nutrient laden silt-like sediment and organic matter was removed from the pond bottom by a small portable hydraulic dredge in the fall of 2008. The dredge slurry was piped to an 11-acre containment area built in a municipal park near the upstream end of the pond. The dredged material was allowed to dry, mixed with onsite sediment, and graded to create a base for an athletic field in December 2010.

Sediment removal created more favorable water depths for local fishery populations, reduced subsequent aquatic plant growth, increased the availability of oxygen in the lower portions of the water column and created contours to provide habitat diversity and refuge areas for fishery populations. Fish habitat structures and turtle basking structures were placed into the pond to further enhance habitat and the pond was stocked with additional largemouth bass and other gamefish by the New Jersey Department of Environmental Protection in the spring of 2009.

Water samples from the pond were collected before construction, during construction, and each year for three years after construction. Samples were analyzed for chemical (nutrients), physical (temperature, depth, oxygen), and biological (bacteria and chlorophyll). This sampling regimen was repeated five times a year once a month from May through September to capture pre-stratification, stratified, and post stratification conditions. The results are being analyzed and compared to historic data.

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Reconstructing Vegetation Response to Altered Hydrology and Its Use for Restoration, Arthur R. Marshall Loxahatchee National Wildlife Refuge, Florida

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Everglades restoration and long-term management of the Arthur R. Marshall Loxahatchee National Wildlife Refuge (Refuge) requires articulation of future desired conditions and development ecologic and hydrologic targets. An understanding of historic conditions, or conditions before substantial land use, is needed for defining desired hydrologic conditions and setting restoration targets. Hydrologic proxies from sediment cores can be used to reconstruct historic conditions and determine whether human-derived changes are greater than those due to natural variability and thus improve our predictions of future responses to different climate and land-use scenarios. We present reconstructed hydrologic and vegetation trends of the last three centuries across the Refuge in order to understand the effects of 20th century water management. We analyzed pollen assemblages from 17 sites along three transects to document vegetation and infer hydroperiod and water depth both before and after human alteration of Everglades hydrology. Results from these sites are used to generate spatial and temporal reconstructions of vegetation and hydrology for the Refuge pre-drainage (prior to 1900AD) and post-drainage (after 1900AD). Both tree island and marsh vegetation were analyzed, but we focus primarily on the response of marsh vegetation. The greatest changes in vegetation occur in post-1950AD sediments after completion of the levees around the Refuge and during a time period of several water management strategies. There are spatial differences in vegetation response to altered hydrology of the 20th century that generally follow the north to south hydrologic gradient created with impoundment. In the northern and central parts of the Refuge, pollen assemblages indicate drying, while sites in the southern part of the Refuge became wetter. Throughout the Refuge, *Sagittaria* pollen declines with the onset of water management, and may indicate a loss of greater variation in hydroperiods between years. Paleocological evidence provides managers with clear estimates of the rate of vegetation response to hydrologic change and vegetational resilience under specific hydrologic regimes. Such information is useful for understanding how past hydrology has influenced current conditions and for forecasting how current and future hydrology may influence future conditions.

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research, Monitoring, and Modeling in Support of Everglades Restoration: A Collaborative Approach

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Addressing the challenges of large-scale ecosystem restoration requires engagement of many organizations. Each organization comes to the table with its own mission, responsibilities, funding streams, and constraints which may appear to be at odds with each other. The most success comes when common goals can be developed and activities are conducted collaboratively and cooperatively. We have developed a collaborative partnership among U.S. Fish and Wildlife Service, U.S. Geological Survey, National Park Service, and University of Florida that allows us to effectively identify and address key science issues related to Everglades restoration. Together we develop research, monitoring, and modeling projects that address management needs and communicate our results in forms usable by resource managers. Major focus areas include a Big Reptile Research Program (alligators, crocodiles, pythons, sea turtles); Wildlife/Habitat/Human Relations (amphibians, mammals, invasive species); Landscape Ecology and Conservation Planning (Climate Change and Risk Assessment); and Education and Outreach. In this presentation we illustrate the management questions being addressed and the outcomes achieved within these programs that would not have been possible without collaboration.

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Don't Forget About Kermit – A Case Study in Vernal Pool Creation

Kelly Brennan and *Kyle Spendiff*

Parsons Brinckerhoff (PB), Baltimore, MD, USA

As part of the overall mitigation package for the I-95 Express Toll Lanes project, Parsons Brinckerhoff (PB) developed a mitigation plan to enhance upland habitat and improving water quality on the 184 acre Whitemarsh Run Mitigation Site. The plan includes the creation of vernal pools and new wetland areas. The site was formerly mined extensively for sand and gravel but currently consists of undeveloped, forested lands. This case study details the site assessment and design considerations associated with this mitigation plan.

Through a series of field and office meetings with representatives from state and federal regulatory agencies (Maryland Department of the Environment and US Army Corps of Engineers, US Fish and Wildlife Service), Maryland Transportation Authority (MDTA), and project staff, it was determined that the most sensible and potentially successful strategy for creating new wetland habitat on the site was to build a series of vernal pool complexes (seasonal or temporary wetlands). Vernal pools are typically filled by rainfall events, surface runoff, snowmelt, seasonally flooded stream or pond overflow, and in some cases groundwater. Vernal pools support a variety of vertebrate and invertebrate species. Frogs, toads and salamanders are usually associated with vernal pools, but many reptiles, birds, and mammals utilize the vernal pools for foraging, nesting, and refuge habitat. On the Whitemarsh Run site, several species of amphibian have been observed to reproducing in both the existing wetland areas and puddles/tire ruts formed by ATV use.

PB conducted extensive field searches to identify ideal locations for potential vernal pool creation using context sensitive design that stressed the value of existing canopy cover. The vernal pool sites were located in gaps in canopy cover that would receive sufficient hydrology. PB is currently exploring the use of different materials to construct vernal pools to allow for variation in drying times. During the field search, PB also indentified several potential wetland creation locations. To determine whether the hydrology was sufficient to support wetland creation, PB installed a series of shallow piezometers and monitored them for a year long period.

The presence, and dominance, of highly disturbed and porous soils on site, the difficulty of intersecting groundwater, the discovery of relatively large areas of tree clearings in lower quality successional forest stands, and the acquisition of the abandoned BGE Right Of Way property, were factors that determined the mitigation strategy being implemented throughout the site.

In addition to the vernal pool and wetland creation and enhancement work, PB was also involved in the development of invasive species management, reforestation and planting plans.

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The Importance of Stakeholder Involvement in Small Watershed Action Plans & Maintaining Stream Health

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The development of small watershed action plans (SWAP) are an effective and essential tool for the maintenance and improvement of stream health, particularly in urbanized areas. SWAPs are strategies that outline how we can improve water quality in our stream systems while considering the past, present and future conditions of the watersheds. The plans include a characterization of watershed resources, identification of potential pollution sources, assessment of neighborhoods and special areas and identification of stream geomorphic and habitat instabilities. They examine alternative ways to enhance the watershed and clean up the stream channels, provide conceptual costs and identify appropriate parties for implementing restoration options. Strategies include a combination of government capital projects, actions in partnership with local watershed associations, citizen awareness campaigns and volunteer activities. The key to a successful SWAP is active participation by local stakeholders. Stakeholders include local residents, leaders from the community, business associations and government agencies. Coordination between the stakeholders is essential in the development and full implementation of a SWAP.

Parsons Brinckerhoff (PB) in association with Baltimore County, Department of Environmental Protection & Sustainability (DEPS) will present a case study of the Tidal Back River Small Watershed Action Plan from Baltimore County, Maryland. Over the course of a year, Tidal Back River watershed partners worked together, conducting assessments, identifying restoration opportunities, and engaging the community, in order to build a successful plan. A Steering Committee, consisting of various watershed partners, was formed to develop the Tidal Back River SWAP. This included Baltimore City and Baltimore County personnel, members of the local watershed organization, and leaders from the local community. The Steering Committee met regularly throughout SWAP development. In addition, three stakeholder meetings were held during the planning process, where the public was invited to see displays and presentations about the findings in their watershed to engage citizens and raise awareness about water quality issues. The public meetings were also a great opportunity to solicit input about watershed concerns and restoration actions of interest to the community.

This study also consists of watershed characterizations, GIS data analysis, rapid stream assessment, stormwater management facility assessment, and tidal area assessments. Field assessments utilized protocols developed by the Center for Watershed Protection including neighborhood source assessments (NSA), hot spot investigations (HSI), pervious area assessments (PAA), and institutional site investigations (ISI). The Tidal Back River study will present intensive community and stakeholder coordination efforts and demonstrate the effectiveness of public involvement when combined with environmental science.

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Remote Island Restoration in the Chesapeake Bay through the Beneficial Use of Dredged Material

Kevin Brennan and Mark Mendelsohn

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The Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island is a large scale remote island restoration effort being undertaken by the US Army Corps of Engineers and the Maryland Port Administration (MPA). Poplar Island is located in the upper middle Chesapeake Bay approximately 34 nautical miles southeast of the Port of Baltimore. The goals of the Poplar Island project are to (1) restore remote island habitat in the mid-Chesapeake Bay using clean dredged material from the approach channels that lead to the Port of Baltimore (2) optimize site capacity for clean dredged material while meeting the environmental restoration purpose of the project and (3) protect the environment around the restoration site. The plan for rebuilding Poplar Island was developed through the cooperative efforts of Federal and State agencies as well as private, commercial and environmental organizations. Clean dredged material is being used to restore 1,715 acres of remote island habitat consisting of 840 acres of upland habitat, 737 acres of wetland habitat that is further divided in to high and low marsh and approximately 138 acres of open water embayment. The project develops a long-term strategy for providing viable placement alternatives that meet the dredging needs of the Port of Baltimore while maximizing the use of dredged materials as a beneficial resource.

The restoration of island habitat is necessary and valuable to the Chesapeake Bay ecosystem. In the last 150 years, it has been estimated that over 10,500 acres have been lost in the middle-eastern portion of Chesapeake Bay. This remote island habitat is valuable as resting and nesting sites for migratory and shore birds. To date 100 acres of wetlands have been created at Poplar Island. An adaptive management plan has been developed and provides the framework for managing the goals of habitat restoration and site development.

Even with the project still in its early stages of development it has exceeded expectations for wildlife usage. So far, a total of 168 species of birds are using the island and 23 species of birds are confirmed nesting within the project site including such desired species as American Black Duck, Tri-colored Heron, American Oystercatcher, Black-necked Stilt, Willet, Common Tern, Least Tern, Purple Martin, Bank Swallow and Seaside Sparrow. Diamondback terrapins, which are now a protected species in the State of Maryland, have laid 157 nests in 2010 that yielded 685 hatchlings.

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Coastal Societal Vulnerability Index for the Northern Gulf of Mexico

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The Gulf of Mexico was identified by the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007) as highly vulnerable to sea-level rise, based on a combination of physical and societal factors. Vulnerability to projected increases in sea level is a critical area of uncertainty for communities and local governments in the extremely low-lying and flat northern Gulf of Mexico coastal zone. A growing population along some parts of the Northern Gulf of Mexico coastline is further increasing the potential societal and economic impacts of projected sea-level rise in the region, where observed relative sea-level rise rates range from 2.98 to 9.95 mm per year in Louisiana, Mississippi, and Alabama. A prior coastal vulnerability index (CVI) developed by Pendleton et al. (2010) was used to map the vulnerability of the region to sea-level rise at a local scale, based strictly on physical characteristics such as local shoreline erosion rates, tidal information, coastal topography, and other variables.

The Coastal Societal Vulnerability Index (CSVI) further includes anthropogenic factors to CVI that contribute to societal risk from sea-level rise impacts. The index highlights the relative susceptibility of coastal communities indicated by the presence of human populations, buildings, and infrastructure that will potentially be displaced by sea-level rise. The incorporated societal variables include human population data, urban landcover data, the locations of key infrastructure, and building density. The variables are ranked by vulnerability level and combined to produce a quantitative index value for each 1-kilometer coastal segment that highlights areas where human populations and the built environment are most at risk. This information can be used by coastal managers as they allocate limited resources for ecosystem restoration, beach nourishment, and coastal protection infrastructure. The study indicates a high degree of variability in index values along the Louisiana, Mississippi, and Alabama coastline, which highlights areas where long-term planning is particularly needed to enhance resiliency.

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International Exchange on Climate Change Adaption in Ecosystems between the United States and the Kingdom of the Netherlands

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In 2007 Florida Earth Foundation began a science and policy exchange program between Florida and the Netherlands called the Florida-Holland Connection Project. Teams went to the Netherlands to take a look at Dutch methodologies in addressing challenges in water management, climate change and growth stewardship. Participants included professionals from state agencies, the US Army Corps of Engineers, industry and academia. In 2010 the program expanded to two teams. The first focused on ecological and environmental Dutch experiences and was designed for US Department of Interior interests. The second group focused on technical and engineering disciplines that have built a substantial reputation for Dutch ingenuity.

In 2011, in response to the White House Council on Environmental Quality's Task Force on Climate Change Adaptation efforts to connect further with international efforts, the Florida-Holland Connection Project is instrumental as a method to stimulate dialogue and exchange between the two countries and serves as a model for international expansion of dialogue and exchange. Participants had the opportunity to talk with Dutch officials, professionals and academia as they viewed ecosystem innovation. Although the Delta Works project brought engineering impetus to the Dutch, focus is now centered on how climate change will dictate societal interfaces with the natural system, especially with sea-level rise. A highlight of the trip is the explanation viewing of the Room for the River project, which has significant impact on Dutch riverine, urban, agricultural and coastal systems, as well as the Building with Nature program of the world famous Deltares Institute in Delft.

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Louisiana Coastal Restoration and LCA Overview, Corps of Engineers Perspective

Darrel Broussard and *Mark Wingate*

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The critical need for near-term coastal restoration in Louisiana is well documented. Wetland loss in coastal Louisiana has reached catastrophic proportions, with 25-35 square miles of Louisiana coastal wetlands being lost every year. Hurricanes Katrina and Rita hastened that loss, destroying 217 square miles of coastal wetlands in two days. Without efforts to protect and restore coastal wetlands, much more will be lost in the next 50 years.

The disappearance of wetlands threatens the productivity of Louisiana's coastal ecosystem, the economic viability of industries, and the safety of residents. Louisiana's coastal area is the largest expanse of coastal wetlands in the contiguous US and produces \$67 billion in oil and gas annually, a quarter of the nation's total fishing industry, and five of the top 14 largest sea ports in the US. The Corps is actively engaged in ecosystem restoration and planning through numerous programs, which are being drawn upon by the CEQ LA-MS Gulf Coast Ecosystem Restoration Working Group Roadmap, and are expected to feed into Sec. Mabus' Long Term Recovery Plan after the Deepwater Horizon Oil Spill, and President Obama's Gulf Coast Ecosystem Restoration Task Force.

The LCA program, as authorized by Congress in WRDA 2007, includes 15 near-term coastal Louisiana restoration projects and a science and technology program intended to resolve coastal restoration uncertainties. Feasibility studies for several of those projects, known as the LCA 6, were finalized in 2010 and addressed various ecosystem restoration projects including barrier island restoration, freshwater and sediment diversions from the Mississippi River, and creation of wetlands. Congressionally mandated deadlines for the LCA 6 studies required adhering to aggressive compressed schedules, close coordination within the Corps, and close and continual coordination with the State of Louisiana and the NGOs. With the Corps and the State each leading three of the six studies, numerous issues and challenges arose which required quick resolution. Issues resolution required extensive coordination both within the Corps, and between the Corps and the State, the NGOs and other Federal agencies. The issues included, but were not limited to, aligning study schedules, reviews, and reporting requirements within the Corps; resolving work-in-kind issues; interpretation of WRDA 2007 Corps policy; the content of the non-Federal sponsor's views, letters of intent, and cost share agreements; and coordination and the need for additional analysis and meeting requests by other Federal agencies and NGOs.

This presentation will include an overview of the need for Louisiana coastal restoration, the LCA Program, and the Corps perspective of challenges and resolutions as described above, leading to a final feasibility report on 6 complex studies over a 24-month period.

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Analysis of Flooding and Sediment Transport by Numerical Modeling as Part of the Don River Mouth Naturalization Project, Toronto, Ontario

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Part of the planning for the revitalization of the Toronto Waterfront is the naturalization of the mouth of the Don River. Flood protection of the lower Don River is a key component of this project, along with sustainable sediment management throughout the study area. Toronto and Region Conservation Authority has identified the lower Don River as the number one priority for flood protection in their jurisdiction.

Detailed two and three dimensional hydraulic modeling of the Lower Don River was undertaken as part of the Don Mouth Naturalization and Port Lands Flood Protection Project Environmental Assessment (DMNP EA). The overall EA includes assessment of the naturalization design requirements, the integration with urban fabric requirements, as well as the hydraulic requirements to contain and convey the regulatory flood through the Lower Don River reach to its proposed new outlets. In addition, the EA includes development of methodology and physical requirements for managing deposited sediment (for the purposes of flood containment, maintenance of navigation and protection of the future naturalized river mouth), while being cognizant of other flood protection works in the vicinity.

This presentation discusses the analysis of flooding, flood protection performance and sediment transport through numerical modeling of the mouth of the Don using the Delft3-D hydrodynamic and sediment transport model. This includes sediment trap analysis and evaluation of dredging options; assessment of sediment transport and deposition in different naturalized channel alternatives, plus geomorphic analysis, analytical modelling of sediment transport and deposition, and evaluation of the functional design for the restored channel, wetlands and flood spillways. The results of the 2-D sediment transport modeling and 2-D/3-D hydrodynamic modeling were used to evaluate the existing conditions in the Project Study Area, and the preferred alternative that was selected through the evaluation of potential alternatives for channel restoration.

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Environmental Flows and the Sustainable Rivers Project

Lisa T. Morales¹ and Andrew Warner² – presented by **Chris Budai**

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It is estimated that more than 60% of the world's rivers are impacted by hydrological alterations, with changes in their natural flow patterns that degrade ecosystems and the services they provide to people. Expanding awareness and understanding of the need to safeguard aquatic ecosystems has led to an evolution that began with protecting minimum instream flows and is now focused on protecting more holistic "environmental flows". Environmental flows are flows of water in a river or lake that sustain healthy ecosystems and the goods and services that humans derive from them. Incorporating environmental flows into water management has become recognized as a way to address some of the unintended impacts of dams and water development.

While much of the early work on holistic environmental flows was advanced outside the United States, the Sustainable Rivers Project (SRP) has emerged as the largest coordinated environmental flow restoration program in the world. The SRP, formally established in 2002, is a collaboration between the U.S. Army Corps of Engineers (Corps) and The Nature Conservancy (TNC) designed to modify dam operations to restore and protect the health of rivers and surrounding natural areas while continuing to meet authorized project purposes, such as flood control, water supply, and power generation. At the heart of the SRP is work at eight demonstration sites across the United States containing 36 federal reservoirs in 12 states. This site-based work involves quantifying and implementing environmental flows, with monitoring to support adaptive dam management.

The Corps owns and operates 692 dams nationwide, and the methods and tools developed through the SRP are being transferred to help initiate similar work beyond the current demonstration sites. Corps infrastructure projects, such as dams, have been authorized by Congress to meet a specific set of purposes. These dams and other Corps flood risk management efforts reduce the risk of flood damages to homes and property within the watershed as well as to vital infrastructure such as energy grids and transportation networks. Corps planners and managers are increasingly faced with the challenge of meeting multiple – and at times competing – demands for water nationwide. Social expectations for flood damage reduction, water supply, navigation, hydropower, recreation and environmental protection and restoration are further complicated by uncertainty in future patterns of precipitation and river flows. This presentation will provide an overview of the SRP and a status of work being conducted by the Corps, TNC, and other partners.

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Monitoring/Evaluation Planning for Environmental Flows on the Middle Fork of the Willamette River, Oregon – A Sustainable Rivers Project (SRP)

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The Willamette River in western Oregon supports a rich diversity of aquatic flora and fauna. It is also home to the majority of Oregon's population, with numerous cities and towns situated along the river and its tributaries. The U.S. Army Corps of Engineers operates 13 dams in the Willamette Basin, with flood damage reduction a primary purpose, and hydropower, irrigation, recreation, and flow augmentation for fish and wildlife additional authorized purposes. Operation of these dams has resulted in alterations to the flow regime, which have significantly impacted the fish and wildlife populations that depend on instream and floodplain habitat.

To address this issue, the Corps and The Nature Conservancy are partnering to determine environmental flow requirements downstream of the dams, and to identify opportunities to restore key aspects of the flow regime. Initial efforts have focused on the Middle Fork Willamette River, which contains 4 of the 13 dams, with recent efforts in the McKenzie River. Using hydrologic and ecological data, information from the literature and expert knowledge, a set of environmental flow targets, including fall and winter high flow pulses, winter bankfull flows, and summer low flows were identified. The Corps implemented initial environmental flow releases on the Middle Fork from 2008-present to evaluate and test the process.

Current efforts include the preparation of a monitoring and evaluation plan and developing tools and techniques to assess the effects from past and for future environmental flows. One aspect of the plan includes monitoring the physical environment to determine how much of the floodplain becomes connected during these releases and what happens in the surrounding physical environment. Physical monitoring includes measuring the movement of sediment, gravel, and wood, evaluating water temperature conditions, and determining where the water goes during various environmental flow releases. Another aspect of the plan monitors the biological component of the ecosystem, including ESA species, to determine if the environmental flows are providing benefits, such as improvements in fish spawning and rearing habitats, western pond turtle habitat, and recruitment of cottonwood and other riparian plant species.

As 1 of 8 demonstration sites in the national Sustainable Rivers Project, the lessons learned from the Willamette River will provide key information for future efforts to advance environmental flow restoration.

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Valuing Information with Predictive Models in the Missouri River Recovery Program

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In this presentation, we summarize the application of numerical models to decision-making in the Missouri River Recovery Program (MRRP), and demonstrate the method we use to prioritize critical uncertainties research for improving models. The MRRP Emergent Sandbar Habitat program is focused on recovery of piping plovers (*Charadrius melodus*) and the interior population of least terns (*Sternula antillarum*) through restoration of in-channel nesting habitat. As part of the adaptive management program for the MRRP, we are developing predictive models for both bird species to support decisions about habitat restoration and population recovery actions. The models link processes that affect nesting habitat availability (mechanical and natural creation of sandbars, erosion, river stage) to population processes (reproduction, survival, dispersal) to predict the impact of restoration actions on bird populations. Numerical models are a method for explicitly linking the multiple processes that connect actions to outcomes, and thus provide predictive comparisons between alternative sets of actions. In doing so, the models capture and summarize the current state of information about the system, and regularly incorporate newly obtained information as an integral part of the adaptive management process. As we use models to synthesize information and make predictions about the future, we can also use them to examine the information itself.

As in many restoration programs, decisions and supporting models in the MRRP are challenged by a significant amount of uncertainty at multiple levels. These range from limited information about bird population processes and the effectiveness of habitat restoration methods, to a lack of knowledge and control over factors such as future weather conditions. In addition to choosing habitat or population management actions, decision makers must also allocate limited resources to research and monitoring programs in order to reduce uncertainty and optimize the learning process. As models quantitatively summarize both information and uncertainty about that information, we can use them to address decisions about learning as well. Assessing the value of perfect information allows us to determine which sources of uncertainty, if removed, would most reduce model variability. Sensitivity analysis determines the impact of the accuracy of information, and the consequences of being wrong about a particular model input. In the MRRP, we can not only prioritize research needs relative to each other, but can also link the costs of research to benefits in terms of potential savings in management costs as uncertainty is reduced. As the two bird species of concern differ in life history and behavior, we compare the results of the prioritization and cost-benefit analysis between least terns and piping plovers. For example, information about base reproductive rates are the most important for predicting fledge ratios precisely for both species, but improving information about survival is more critical for terns than for plovers. Preliminary results for plovers suggest that perfect information for plover productivity intercepts could result in the largest savings in construction costs, nearly twice as much as survival rates.

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Ecosystem Restoration Efforts on Private Lands: The Role of Farm-scale Planning and Delivery

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Approximately 71% of the contiguous lower 48 states are in nonfederal, rural land use. The degree to which this land base produces environmental services and products is in the hands of private individuals who own and manage forest, agricultural, and range lands to produce a myriad of goods, services, and intangible values. Large-scale ecosystem restoration and conservation will require integration of cost effective and sustainable conservation practices into mainstream agriculture and forestry production systems. The health of local wildlife populations, communities, and ecosystems is influenced not only by local environmental conditions and land use, but also by the structure and composition of the landscape at larger spatial scales. As such, maintenance of viable populations of many species and attainment of other environmental goals, such as nutrient reduction, water conservation, and water quality, requires conservation planning at continental, regional, and watershed scales. Thus, conservation planning must be hierarchical, but the success of large scale conservation planning efforts is ultimately dependent on the success of planning and delivery at the farm-scale. Landscapes are changed, one landowner at a time. To effectively integrate regional and national conservation objectives into conservation plans, resource planners must have an operational understanding of key ecological principles. This knowledge is then translated into changes on the landscape through comprehensive planning and implementation at the farm scale, within the context of the larger landscape (watershed, physiographic region, etc). Effectiveness of conservation programs and practices must be clearly defined and measurable at local, regional, and national scales in terms of outcomes (e.g. population changes, enhancements in water quality, reductions in downstream nutrient delivery) and not simply outputs (e.g. acres of conservation cover, miles of conservation buffers, etc.). I illustrate these principles of effective conservation on private lands with case studies.

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Alternative Substrates as a Native Oyster Reef Restoration Strategy in Chesapeake Bay

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Oyster shell for native oyster (*Crassostrea virginica*) reef restoration is scarce in Chesapeake Bay and other estuaries. Consequently, alternative substrates merit consideration in oyster restoration. Over a five-year period, I examined the suitability of shell alternatives, including granite, concrete, limestone marl, concrete modules and reefballs with reef surveys and experiments in the Rappahannock and Lynnhaven Rivers of Chesapeake Bay. Oyster recruitment, growth, survival, density, biomass, condition, and disease stress, as well as reef accretion and persistence, were measured. In the Lynnhaven River, intertidal riprap had a mean density of 978 oysters m^{-2} (165 g AFDM m^{-2}) and peak densities > 2000 oysters m^{-2} , which are among the highest abundances on alternative reefs, shell or otherwise. Riprap reefs supported a robust population size structure, signifying consistent annual recruitment and reef sustainability. Riprap age (older $>$ younger) and location influenced reef performance; granite and concrete both supported dense oyster-mussel assemblages.

In 2005 and 2007, oyster and mussel population structure, density and biomass were quantified on a novel, subtidal concrete modular reef deployed in 2000 in the Rappahannock River. The reef was not seeded or harvested. Densities (m^{-2} river bottom) were very high for oysters (2005: 991 m^{-2} ; 2007: 2191 m^{-2}) and mussels (2005: 8433 m^{-2} ; 2007: 6984 m^{-2}) and comparable to the highest densities on shell reefs. An adjoining 0.44 ha array of concrete reefs (Steamer Rock) was deployed in 1994 and sampled in 2006. These reefs contained > 4 million oysters and > 30 million mussels. Oysters from both reef systems had low disease prevalence and intensity.

In a field experiment, treatments simulating oyster habitat were placed at three intertidal sites in the Lynnhaven River. Granite had highest oyster recruitment and abundance (density > 1500 m^{-2} and biomass > 200 g AFDM m^{-2}). Many reefs reached a mature state after two years. By Year 3, some reefs had accreted 15-20 L of shell m^{-2} river bottom, and contained three year classes; some treatments had > 30 % of live oysters growing on other oysters. Large oysters (> 95 mm shell height) had lower intensities of Dermo infection than smaller (60-90 mm) oysters. These patterns indicate that oyster disease tolerance has developed in these high-salinity waters, and highlight the importance of substrate type and reef location in ecological oyster reef restoration.

In summer 2006, nine reefs were constructed at two shoreline sites in the Lynnhaven River, three each of oyster shell (OS), riprap (RR), and concrete modules (CM). Six reefballs were placed at each site, half pre-seeded with hatchery-reared oysters. Finally, *in situ* setting of triploid oyster larvae on OS, RR and CM reefs was attempted. After 2.5 yrs, all reefs had high oyster density and biomass (unseeded: 150-1200 m^{-2} , 150-600 g AFDM m^{-2} ; seeded: 30-1800 oysters m^{-2}), and sustainable accretion rates (8-15 L m^{-2} yr^{-1}); diploid and triploid oysters had light Dermo infections. Consequently, alternative substrates can serve as effective oyster reefs under diverse conditions in subtidal and intertidal environments of Chesapeake Bay.

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Ecosystem Modeling for the Missouri River Cottonwood Management Plan

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In compliance with the U.S. Fish and Wildlife Service (USFWS) Biological Opinion (Bi-Op) regarding the Missouri River Operation activities, the Omaha and Kansas City Districts are actively pursuing restoration and preservation initiatives to offset past losses of cottonwood forests due in part to damming and channelizing the Missouri River in the early 1950s. Because the study area encompasses an enormous geographic range (1,500+ river miles flowing through 7 states), a decision was made to divide the system into 13 segments (six of which were designated as priorities by USFWS), and address the restoration/preservation of each segment in an incremental (segment-by-segment) fashion. However, the functioning of the system's cottonwood riparian ecosystem can be affected by the current and future conditions at the local, regional and basin-wide scales. As such, the emphasis placed on a "systems" approach to the Missouri River Bi-Op's planning process has given rise to the need for methods to characterize habitat conditions now and in the future in a portable, adaptive manner with landscape-level sensitivity. As part of the cottonwood management planning effort, ERDC has developed a conceptual model for the system replete with system drivers, stressors, essential ecosystem components and endpoints that in turn have been used to devise a community-based index model for the cottonwood community along the entire 1,500 miles of river. This collective toolset is being employed to characterize the current state of the ecosystem today, and evaluate and assess the outputs of proposed preservation and restoration plans in the first of the six segments in the study (Segment 10 – a 59-mile stretch of "Wild and Scenic" Missouri River flowing from Gavins Point Dam to Ponca State Park in South Dakota and Nebraska). Here we provide a detailed look at ERDC's models cottonwood toolset – the model components, interdependencies, and overall composition. A discussion of the modeling and application process will include our reference-based approach to calibration (including historical pre-damming characterizations); the expert elicitation strategies used to forecast landuse conversion, forest succession, and potential global climate change factors; the risk and uncertainty analysis incorporated into the plan formulation and evaluation efforts; and ultimately the development of a standardized, integrated planning procedure that ERDC is now using to systematically evaluate the segments (both upstream and downstream) highlighted in the Missouri River Bi-Op's cottonwood management plan using multi-scaled (both spatial and temporal) adaptive management paradigms across the system.

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Managing Implementation of an Ecosystem Restoration Program

Eric Bush

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The South Florida Everglades Restoration Program includes multiple projects and program-level activities with an overall estimated program cost of approximately \$20 billion involving all phases of project implementation, from initial planning and design through construction and long-term operations, maintenance and repair. To manage this enormously complex program, the U.S. Army Corps of Engineers and the South Florida Water Management District have developed and implemented a series of management policies, procedures, and tools. This presentation will provide: (1) an overview of program and project management guidance, including linkages to legal authorities and cost-sharing requirements; and (2) an overview of program and project management procedures and tools.

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Watershed Planning for Restoring Sustainable Ecosystems in the Ohio River Basin

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The Ohio River Basin is an ecologically-diverse hydrologic system covering 15 states and 528,357 square kilometers. The Ohio River contributes 60 percent of the nominal flow in the Mississippi River at Cairo, IL. The Cumberland and Tennessee rivers contain over 60 threatened and endangered aquatic species (fishes and mussels) and are world renown for their diversity and production of ecosystem services. Over 27 million people live and work within the basin and millions outside of the basin depend upon the electric power generating capacity of the basin's 400 power plants. US Census projections for 2030 forecast 3 million people added to the basin population requiring more dwellings, expanded transportation capacity, sewer and water infrastructure, and producing more wastes to be assimilated by an already over-stressed ecosystem. There are over 1,000 CSO's identified by Ohio River Valley Sanitation Water Sanitation Commission (ORSANCO) along the Ohio River alone. From that same aquatic resource over 5 million people and countless industries withdraw millions of gallons for processing, cooling and consumption daily.

The Corps Ohio River Basin Comprehensive Reconnaissance Study (USACE 2009) identified numerous issues including aging public infrastructure, sustaining water supplies for millions of people and recurring loss of life and damages from flooding. Uncontrolled land cover change, deteriorating water quality due to non-point source pollution and nutrient loading, hydromodification and lack of stormwater management pose significant threats to the aquatic ecology of the region. Abandoned mine lands and other resource extraction techniques (hydraulic fracking) threaten the availability and quality of water in the basin. These issues are described in the Corps 2009 report and each begs for application of ecosystem restoration techniques in a well-coordinated and sustainable plan. That strategic plan is now being developed on a watershed-by-watershed basis.

A concurrent collaborative effort by the Ohio River Basin Fish Habitat Partnership to restore fish habitat in the upper Ohio River basin has resulted in the development of a strategic plan for addressing many of the ecosystem issues identified by the Corps, the US Fish and Wildlife Service, The Nature Conservancy and many of the 15 state Departments of Natural Resources. Early actions for restoration in that strategic plan coincide with recommended actions for ecosystem restoration in the Corps' reconnaissance plan. A series of five initial Watershed Assessments is being launched at the sub-basin level to assess the land and water related ecosystem issues. Collaborative efforts by the Corps, the Ohio River Basin Fish Habitat Partnership and the Partnership members will be focused on restoring the diversity and productivity of the basin ecosystems.

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Landowner Participation in Implementing the Landscape Conservation Cooperatives: Science and Policy Implications of Payment for Ecosystem Services Programs

Frank Casey and Carl Shapiro

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The Department of the Interior is creating a network of 21 Landscape Conservation Cooperatives (LCCs) that will engage federal, state, and local resource managers, as well as private partners and the public, in crafting practical, landscape-level strategies for managing climate change impacts. LCCs partnerships will inform conservation delivery on the ground and provide a forum for identifying common science questions and needs across their respective geographic regions.

The new USGS Center for Science, Decisions and Resource Management is investigating whether or not LCCs can benefit from establishing payments for ecosystem services (PES) to create the necessary incentives for private agricultural and forestry landowner's participation. Institutional issues will also be addressed. This presentation will inform public land managers and LCC directors about the potential viability and issues surrounding PES programs.

There is a lot of discussion and piloting of projects concerning the viability of payments to private and public resource managers for the conservation and restoration of ecosystem services that are adjacent to or use public lands. Much of the policy debate and on-the-ground work thus far has been focused on the "demand side" through the testing and establishment of different market or quasi-market structures, determining efficient and verifiable metrics for monetizing ecosystem service credits, and the identification of potential buyer communities. Conversely, there has been relative less inquiry into the conditions and motivations under which private and public resource managers would choose to work together and participate in payment for individual or bundles ecosystem services (PES) programs and or markets (the supply side).

Based upon recent landowner socio-economic survey data and analysis, this paper will discuss the factors that influence resource manager decisions to participate in programs designed to restore and pay for ecosystem services (wildlife habitat, carbon sequestration, water quality and quantity) that can also impact the conservation priorities of the LCCs. A case study involving California ranchers will be used to discuss the economic trade-offs that resource managers make with respect to PES program attributes, and the marginal values that managers place on key attributes: contract amount, length of contract, and implementing agency. The application of the findings to public resource management decision making and adaptation, specifically within the context of the LCCs, will be discussed. Results from the case study will help establish a mechanism to help inform LCC policies and institutions with respect to the engaging private landowners in meeting LCC objectives.

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The Evolution of an Idea and an Institution: Assessing the Progress of the Army Corps of Engineers in Large-scale Ecosystem Restoration in the Florida Everglades

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Large-scale ecosystem restoration came to national attention with passage of the Comprehensive Everglades Restoration Plan (CERP) ten years ago. CERP's federal implementer, the Army Corps of Engineers (Corps) has long been criticized for its environmental practices in traditional mission areas such as flood control and wetland fill permitting, and the new mission of ecosystem restoration represents in many ways a departure from those "old" lines of work. The agency has acknowledged a need to change its institutional culture in response to environmental needs as well as evolving technology, budget priorities, and other contextual realities (USACE Learning Organization Doctrine 2003). The Everglades is the first and most extensive large-scale ecosystem restoration conducted by the Corps, but to date CERP progress has principally consisted of plan formulation, design, and implementation, with project construction having only just begun. Without the ability to use traditional ecological tools to measure outcome success in restoration, it is difficult to assess progress.

Given that practices influenced by the traditional culture of the Corps have often led to negative environmental outcomes, it seems probable that a more adaptive institutional culture will provide increased opportunities for positive environmental outcomes. This cultural change may eventually influence all aspects of the Corps' missions, but it seems likely to manifest itself first in those districts and teams working most intensively on environmental issues—in particular, the Jacksonville district, home to the Everglades Division.

Accordingly, I interviewed fifty individuals involved in the field of Everglades restoration to assess attitudes regarding the Corps and its progress towards both cultural change and restoration. Sixteen interviewees were current or former employees of the Corps, from project manager to senior policy levels. I drew the additional thirty-four interviewees from other federal, state, and local agencies, environmental organizations, the Everglades agricultural community, tribal groups, academia, and other backgrounds. I asked interviewees to discuss their goals for restoration, what they felt were the Corps' goals, successes and failures of the Corps in ecosystem restoration, openness to public involvement, adaptive management, use of science in planning and implementation, relationships among agencies, and other topics.

Interviews were transcribed, coded, and analyzed for frequency and relationships of topics. The results paint a picture of an agency adapting to its new mission of environmental restoration. The Corps, especially at the district level in Jacksonville, is gradually learning to balance budget priorities, bureaucratic culture, tension between state and federal goals, and the competing priorities of flood control, agriculture, population growth, adaptation to climate change, and environmental stewardship as it seeks to restore the Everglades to a healthy and productive ecosystem.

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Ecosystem Restoration at the Vermont Asbestos Group Mine Site

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The Vermont Asbestos Group mine is an inactive asbestos mine in Northern Vermont. A majority of the mining took place between 1936 and 1993 when the mine closed. Approximately 40 million Tons of barren waste rock and tailings are present at the site. Ongoing erosion of the steep tailings piles has impaired downstream wetlands and streams. Preliminary estimates of the cost to stabilize the piles by re-grading and establishing 1-2 ft. of cover soil range from \$135-207 million. The mine waste has remained barren due to the intense infertility of the coarse textured materials. Asbestos mine waste is ground serpentinite rock. The ground rock is severely Ca and P deficient, potentially Mg toxic, and deficient in many plant nutrients. It has very little organic matter; these rocks are also rich in Ni, Co and Cr, and alkaline due to the Mg silicate host rock. The site has remained barren despite surrounding land with dense forest cover. US-EPA and VT-DEC asked USDA-ARS to cooperate in seeking a less expensive method to revegetate the site rather than importing 1-2 ft. of topsoil. We had previous success at long barren highly sloping Zn-Pb mine sites using compost, biosolids, alkaline byproducts and other amendments to established stable vegetative cover.

Recognizing the infertility problems of such serpentinite mine waste, we conducted a greenhouse pot test of using composted manure plus yard debris, compost plus gypsum (CaSO_4), and a local topsoil (as positive control) compared with the unamended control mine waste or mine waste plus normal NPK fertilizer used in revegetation. The compost amendment was 5 cm deep over the mine waste, simulating surface application on sloping mine waste. Nine plant species were tested on these treatments including cover crops for northern Vermont soils. Severe Ca and P deficiency of serpentinite usually prevents root penetration and rapid seedling death.

The results showed a remarkable contrast of little or no growth on mine waste even with NPK fertilizer added, compared with the compost and compost+gypsum treatments. Without the compost, few plants survived and roots were found at the outer edge of the pots. But with the compost and especially with compost+gypsum, plants thrived and roots penetrated the mine waste in high density. The pot experiment results were so successful that field demonstration plots were established in late August, 2010, to test mixtures of commercial compost products (manure, yard debris, etc.) with NPK fertilizer and gypsum. A mixture of cover crops (perennial ryegrass, tall fescue, Kentucky bluegrass, alsike clover and annual rye) were seeded. The cover crops became established before snowfall, and the current status will be reported at the Conference. Technical results from analysis of the plants from the greenhouse test will also be reported. Success in revegetation requires attention to soil chemistry and plant nutrition.

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Underwood Creek Rehabilitation and Flood Management, Wauwatosa, Wisconsin

Thomas R. Sear¹, Ivette Bolender², Paul Kovalcik² and Charles A. Uhlarik³ – presented by **Tom Chapman**

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Underwood Creek is a major tributary of the Menomonee River, extending approximately eight miles upstream from its confluence with the Menomonee River, in the City of Wauwatosa, Wisconsin. The Underwood Creek Sub-watershed is approximately 84 percent developed with a variety of urban land uses. Given the need to address flood management concerns, Underwood Creek underwent considerable alteration in the early 1970's, including floodplain filling, channel widening and realignment, and the installation of concrete lining. Following severe flooding that occurred along the Menomonee River in the late 1990's, the Milwaukee Metropolitan Sewerage District (MMSD) initiated the *Milwaukee County Grounds (MCG) Floodwater Management Facility Project*, which included the development of an overflow diversion structure adjacent to Underwood Creek and an approximately 900 acre-feet floodwater storage facility on MCG property that will receive and detain excess floodwaters. The MCG Project provided an opportunity to rehabilitate approximately 6,600 feet of Underwood Creek watercourse through the removal of concrete channel lining; the development of a replacement bioengineered channel, with riffle and pool sequences; and the reactivation (lowering) and re-vegetation of the adjoining floodplain. Rehabilitation goals are based on the desire to increase natural functions including providing floodplain storage and water quality benefits; increasing biodiversity; restoration of in-stream, wetland and upland habitat; and eradication of non-native plant species.

The MMSD *Underwood Creek Rehabilitation and Flood Management - Phase 1 Project* was recently completed and addressed the final design and construction of rehabilitation improvements along approximately 2,200 feet of watercourse, including the development of approximately 5 acres of riparian wetland floodplain. The Underwood Creek "Phase 2" watercourse segment, located immediately downstream of the Phase 1 project area, is currently being addressed in a feasibility study by the US Army Corps of Engineers per the authority of Section 206 of the Water Resources and Development Act (WRDA) of 1996, (P.L. 104-303) as amended. The US Army Corps of Engineers *Underwood Creek Section 206 Feasibility Study* includes the rehabilitation of approximately 4,400 linear feet of Underwood Creek watercourse and the development of approximately 2 acres of wetland floodplain. The Underwood Creek Phase 2 watercourse segment is highly constrained, and is bordered by a Canadian Pacific Railway (CPR) right-of-way on the south and a mixture of residential, institutional and commercial properties on the north. Principal goals of the Phase 2 project include ecosystem restoration through the removal of concrete channel lining and five concrete drop structures, and the development of a rehabilitated stone lined channel, with riffle and pool sequences and a hydrologically connected floodplain. These improvements must be accomplished while providing appropriate flood management and accommodating fish passage for targeted species.

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Lower Columbia River Large Scale Adaptive Hydraulics Model: Holistic Planning Approach for Ecosystem Restoration in Estuaries

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The Columbia River is the largest river in the Pacific Northwest region of North America and has the greatest flow of any North American river draining into the Pacific Ocean. With a monthly average discharge in the range of about 100,000 cubic feet per second to 500,000 cubic feet per second, the Columbia River is the fourth-largest by volume in the U.S. The Columbia River Estuary is located in northwest Oregon and southwest Washington, starting near Astoria, Oregon and ending at about river mile 46. The Lower Columbia River Basin includes all tributaries and their watersheds that drain into the Columbia River from its mouth to river mile 146. There are many tributaries into the Columbia River including the Snake River, Deschutes River, Lewis River, Cowlitz River and Willamette River. The Willamette River flows from the Cascade mountain range, through the Willamette valley and into the Portland Metro region. The Willamette River is a major tributary of the Columbia River and contributes 12% to 15% of the total flow. Restoration, habitat enhancement and habitat creation efforts are crucial within the lower Columbia River Basin and in the Estuary in order to mitigate the effects of human activities since the 1870's. Most recently, the Columbia River Channel Improvement Project, which deepened the navigation channel from 40 feet to 43 feet below the Columbia River Datum, requires Ecosystem restoration as part of the adaptive management plan.

This poster illustrates a recently developed large scale Adaptive Hydraulics (AdH) model for the lower Columbia River and Willamette River for use as an eco-system and habitat restoration planning tool for various projects within the tidally influenced portion of the Columbia River. AdH is the US Army Corps of Engineers' next generation unstructured multi-dimensional mass conserving finite element physics based hydrodynamic model code that utilizes automatic, run-time grid refinement and un-refinement to obtain the best hydrodynamic solution for the least computational cost. The hydrodynamic portion of the model code includes: shallow water equation methods for estuarine, riverine, etc. problems; Navier-Stokes (full physics) methods for calculation around structures such as fish ladders; and unsaturated ground water methods. The shallow water component includes multi-dimensional modules for: constituent transport such as salinity; modules for fine, coarse and mixed sediments with bed structure; and modules for water quality and ecological work such as ICM, CASM, and NSM. AdH is written in a library format to facilitate collaboration and the addition of new physics, water quality and ecological processes, including libraries for turbulence closure, sediment transport, friction, water quality, ecology, wave processes, and structures, among others. Planned use of AdH provides decision support system to conduct "what-if" analysis involving circulation, salinity, sediment transport, water quality and ecology for project sites within estuaries during the planning phase of eco-system restoration programs. The model can be downloaded for use at <https://adh.usace.army.mil/>

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Overview of the Mississippi River Basin Healthy Watersheds Initiative (MRBI)

Thomas W. Christensen – presented by **Chris Hartley**

USDA - Natural Resources Conservation Service (NRCS), Washington, DC, USA

The Natural Resources Conservation Service (NRCS) has established a number of conservation initiatives where focused efforts are being made to raise awareness, stimulate interest, and generate enthusiasm and commitment for voluntary action to address identified natural resource issues. Initiatives may be landscape or watershed based, such as the Mississippi River Basin Healthy Watersheds Initiative (MRBI); or based on a species, ecosystem, or national issue. In addition to existing base programs, conservation initiatives have dedicated funding that leads to acceleration of conservation implementation. Strong partnerships and focused efforts are crucial to the initiatives' success.

To improve the health of watersheds within the Mississippi River Basin, including water quality, wetland restoration, and wildlife habitat, NRCS established the MRBI in federal fiscal year 2010. Through this Initiative, NRCS and its partners will help producers in focus area watersheds voluntarily implement conservation practices that avoid, control, and trap nutrient runoff; improve wildlife habitat; and maintain agricultural productivity.

MRBI is available in selected watersheds in Arkansas, Kentucky, Illinois, Indiana, Iowa, Louisiana, Minnesota, Mississippi, Missouri, Ohio, South Dakota, Tennessee, and Wisconsin. Existing NRCS programs will be used to provide financial and technical assistance to landusers. The Initiative will build on the past efforts of producers, NRCS, partners, and other State and Federal agencies.

Conservation partners have a crucial role in encouraging and supporting producer participation. This includes providing education and outreach activities; providing technical and educational assistance; targeting their agency's or organization's programs toward the Initiative's watersheds; and assisting with monitoring, evaluation, and assessment.

MRBI has adopted a three-tiered monitoring and evaluation approach designed to assess environmental outcomes at the edge-of-field, in-stream, and at the 12-digit HUC level.

NRCS has developed an interim conservation practice standard for edge-of-field monitoring and this practice is available to landusers through the Environmental Quality Incentives Program (EQIP) in this Initiative. NRCS is working with partner agencies on monitoring efforts beyond the edge-of-field.

The outcomes expected from the Initiative include reduced nitrogen and sediment levels in the watersheds of the Mississippi River Basin, as well as improved wildlife habitat and restored wetlands, while maintaining agricultural productivity.

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Calculating Environmental Benefits: Goals, Performance Measures, Performance Targets, and Habitat Units: Teaching Formulation to a New Generation of Planners

Barbara B. Cintron and *Rebecca S. Griffith*

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The Corps of Engineers' aquatic ecosystem restoration formulation process is derived from the process used to estimate monetized (dollar) benefits to justify other types of Corps projects. Fundamentally, the outputs in "habitat units" are compared against alternative plan costs to identify the "best" plan, that plan where the marginal benefit resulting from an increase in scale stops exceeding the marginal cost of that increase in scale. The art of the process lies in identifying, in the absence of a fixed formula, those elements of "success" that reflect project objectives, are most sensitive to different alternative designs *and* most closely tied to the desired hydrologic outcome, either by explicit models or not. All too often, however, the collaborative environment within a PDT fosters an ad hoc approach to the selection of performance measures which, if not properly controlled, can seriously undermine the planning process almost from the start. Teams without strong, experienced planning leadership are prone to developing "consensus" through the selection of too many performance targets, of performance targets that are not sensitive to project objectives or alternatives, and/or mis-identification of measures as project objectives.

Teams working in the Corps' traditional business lines of flood damage reduction and navigation have many struggles, but they do not have these struggles. As a planning community, our reliance on NED evaluation as the "parent" framework for NER evaluation has led us to overlook the fact that ecosystem restoration teams have a whole set of tasks related to defining success and identifying metrics that can be taken completely for granted in projects where the benefits are measured in dollars. As a result, our approach to training planners neglects these essential skills almost completely. And when planning teams lack these skills, bad things happen.

This paper presents a series of case studies focused on restoration planning teams undertaking the process of specifying project goals, selecting performance targets, and developing strategies to estimate benefits. We highlight the critical questions faced by these teams, and explicitly identify the ways in which this evaluation process is fundamentally unlike NED analysis. The paper also addresses some ideas being tested in Jacksonville District to augment traditional planner training in light of the unique challenges of NER planning.

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Environmental Remediation and Renewable Energy Through High-yield Algal Aquaculture

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The Chesapeake Algae Project, an academic and industrial partnership, is working to create harvestable algae growth platforms in natural waters with the dual purpose of environmental remediation and the production of feedstock for biofuel refining. This low-energy approach capitalizes on solar energy, excess nutrients, and tidal cycles to grow filamentous diatomic microalgae on vertically stacked growth substrates, which significantly decreases the footprint of the growing platform. The Department of Physics at the College of William and Mary has tested several sub-scale prototypes which led to the design of a research platform that provides near-optimal growing conditions in a flume-style production system.

The flume configuration was chosen to determine nutrient uptake scales for the purpose of designing production-sized systems. The current device aligns with the prevailing current of the York River and allows measurement of various water quality parameters as the ambient water passes through the algal crop. Preliminary data from various *in situ* instrumentation during the initial Nov. 2010 experiment show a definite drop in ambient phosphate and rise in pH, even at late autumn growth rates.

While the energy content of the wild algal crop is lower than high lipid monocultures, our earlier sub-scale prototypes have shown extremely high summer growth rates which may offset the difficulty in refining, and may provide a significant reduction in excess nutrients that threaten the Chesapeake Bay.

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Storm Surge and Wave Modeling for Prioritizing Coastal Restoration and Protection Projects

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This work is being carried out by ARCADIS on behalf of the State of Louisiana Office of Coastal Protection and Restoration (OCPD). The study is being conducted in order to evaluate the surge and wave reduction potential of many hundreds of coastal restoration and protection scenarios, so that the construction of the restoration projects can be prioritized. The protection potential of the various proposed restoration and protection projects is just one of many evaluation categories which are being included within the larger context of the regional planning study.

The intent of this work is to optimize a coupled hydrodynamic and wave modeling system which would meet the time and accuracy constraints of a statewide planning study by OCPD. The Advanced Circulation (ADCIRC) model coupled with the Unstructured Simulating Waves Nearshore (UnSWAN) model is being utilized. An initial study served to quantify runtime and relative accuracy for several levels of model resolution in order to recommend an optimal model setup. The modeling paradigm makes use a de-refined version of the high-resolution SL18 ADCIRC model, to determine the local effects of proposed restoration and protection projects. The model is used to investigate different coastal protection and restoration options for their impact on local flow and waves during hurricane conditions. One of the strengths of ADCIRC is that it uses an unstructured mesh which allows for variation of resolution from coarse in the open ocean to very fine near islands, channels, and levees and fine resolution where topographic and hydrodynamic flow gradients are large (such as in channels and wave breaking zones). The unstructured mesh allows a very precise representation of the topographic and bathymetric features and accurate representation of the flow conditions, while simultaneously meeting the strict time requirements.

The wave and surge model will be used to compute surge elevations for a suite of hurricane scenarios. The ensemble of simulation results will be used to estimate the 0.2% to 2% change surge elevation. By comparing the difference between the statistical surge elevations computed with the proposed projects to the statistical surface computed with the original scenario, an estimate is derived for the degree of surge protection that could be expected from the proposed, new coastal restoration and protection projects. Using this methodology, approximately 300 potential coastal restoration and protection projects, as well as suites of projects, are being evaluated and prioritized, based on their ability to attenuate hurricane storm surge and waves, prior to funding and construction of the projects.

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Bridging the Science / Decision-Making Gap in the Trinity River Restoration Program

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The strategy for rehabilitation of the Trinity River integrates the restoration of riverine processes with the instream flow-dependent needs of salmonids. The primary components of the restoration strategy are: mechanical channel rehabilitation, gravel augmentation, a variable flow regime to meet fluvial geomorphic and biological objectives, and watershed restoration. Importantly, the strategy also includes an Adaptive Environmental Assessment and Management (AEAM) Program. AEAM is a rigorous approach to environmental management designed to explicitly address and reduce uncertainty regarding the most effective on-the-ground actions for achieving management goals and objectives. In the Trinity River Restoration Program (Program), it was envisioned that the AEAM Program would include scientific monitoring and evaluation efforts, and result in recommended adjustments to the annual flow schedule or other measures in order to ensure that the restoration and maintenance of the Trinity River anadromous fishery. An Integrated Assessment Plan, developed jointly by Program partners and informed by conceptual and quantitative models, provides the framework for assessing the effectiveness of the management actions in achieving Program goals or management targets.

The Program utilizes a broad and distributed governance structure. The AEAM Program is guided by a Trinity Management Council (TMC), a decision making body comprised of senior personnel from the eight federal, tribal, state and local partner organizations. An Executive Director (ED) employed by one of the TMC organizations executes the decisions of the TMC and oversees all Program activities. Program staff representing all partner organizations provides technical support to the TMC and ED through technical work groups. The Trinity Adaptive Management Working Group, a Federal Advisory Committee Act chartered group comprised of 16 members, is charged with representing the stakeholder interests related to the restoration of the Trinity River fishery resources and provides management recommendations to the TMC. Given this distributed governance structure in combination with the varying response times of different system components and the large spatial scale of restoration activities, the Program is challenged to better synchronize our science program with the needs of decision makers.

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Gold Ray Dam Removal – Removal of the Last Fish Barrier on the Lower Rogue River

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Gold Ray Dam was located on the Rogue River in Jackson County, Oregon, approximately six miles northwest of Medford, Oregon. The concrete dam, which was 38 feet high and 360 feet long, was constructed immediately downstream of a log crib dam in 1941. Gold Ray Dam was operated as a hydroelectric facility until 1972 when it was closed by PacifiCorp and ownership was transferred to Jackson County. The dam and associated facilities were in a deteriorated condition, posing life safety, maintenance, and liability concerns for Jackson County. Additionally, Oregon Department of Fish and Wildlife (ODFW) had identified Gold Ray Dam as one of the top priorities for fish passage. Removal of the dam would supplement the recent removal of two other dams and the open 157 miles of the mainstem Rogue River (from the Pacific Ocean to Lost Creek Dam) to native fish migration.

In 2009, Jackson County received a NOAA Coastal and Marine Habitat Restoration Project Grant under the American Recovery and Reinvestment Act (ARRA) to evaluate and potentially remove the then-existing dam structures. Due to federal funding, the project was required to assess the potential impacts of the proposed action on the natural and human environment in accordance with the National Environmental Policy Act, as well as obtain all required federal, state, and local permits and approvals.

As part of this environmental process, a sediment study was performed to determine the quantity and chemical nature of the sediment stored behind the dam. These sediments were determined to be primarily non-contaminated and comprised of beneficial coarse sand and gravel. River erosion of the sediment after dam removal was selected as the sediment removal method. This sediment study was used as the basis of a sediment transport model, which was used to estimate how long it would take for typical river flows to remove the sediments and the impact of the eroded sediment on the downstream river reaches. A hydraulic analysis was used in combination with the sediment transport to estimate impacts to the 100-year water surface elevation, which was necessary for local permitting requirements and to address public concerns about dam removal. The environmental process also included extensive study of the wetlands complex that had developed in the dam's backwater area, assessment of dam rehabilitation as an alternative to removal, and development on a restoration plan including in-stream grade control structures. The environmental process was completed in about eight months and aided by monthly meetings an interagency technical team that addressed issues in process, thus avoiding delays in the process.

The dam's successful removal is part of a larger Rogue River ecosystem restoration effort that included the removal of two other dams. This presentation will provide attendees a historical background of the Gold Ray Dam, a summary of the hydraulic and other environmental analyses and restoration elements, and a walk through the construction process.

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Louisiana Coastal Restoration and Protection Planning Strategies: Projects to Implementation

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The State of Louisiana has lost over 2,400 square miles of coastal land over the last 50 years. The coast continues to be detrimentally impacted by hurricanes and most recently, by the largest oil spill in our history. This land loss is due to many factors, including the loss of sediment input from the Mississippi River after it was leveed in the 1930's. The effects of sediment starvation have been compounded by those of extensive oil and gas activity, particularly the construction of navigation canals that opened pathways into interior marsh for saltwater intrusion. These and other processes have altered the natural coastal hydrology, resulting in the loss of critical wetland habitat. Hurricanes have also decimated barrier islands which protect our diminishing wetlands.

After Hurricane Katrina occurred in 2005, the Louisiana Legislature mandated that the State integrate coastal restoration and protection. With that mandate, Louisiana began to develop coastal protection and restoration objectives that would become the underpinnings for the identification and implementation of projects needed to achieve a sustainable coast. A Master Plan was developed in 2007 that established four planning objectives as benchmarks for implementing coastal projects and identified large-scale measures needed to achieve a sustainable coast. To accommodate the dynamic nature of the coast, the Legislature mandated a five-year update of the Master Plan to incorporate new data and planning tools. The 2012 Master Plan builds on the 2007 Master Plan but also breaks new ground with the development of a systems approach to project evaluation and consideration of real-world constraints in the decision framework. The 2012 Master Plan will also utilize uncertainties and decision criteria to assist in determining resource tradeoffs.

The Office of Coastal Protection and Restoration (OCPR) has begun development of a prioritization tool that will identify a suite of projects and a sequencing order that would make the greatest progress toward a vision based on the 2007 Master Plan's planning objectives. The latest scientific and engineering thinking is being applied to the development of inputs to the prioritization tool. Recognizing that the success of the plan hinges on stakeholder support as well as science, the State has also implemented a comprehensive outreach plan to obtain input and feedback from the public, Federal and state agencies, NGOs, and elected officials.

OCPR's state-of-the-art and systems approach to coastal planning will allow the State to effectively invest limited financial resources while making the greatest progress toward achieving a sustainable coast.

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Restoration of Wetland Habitats Dominated by *Phragmites australis*

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One of the most troublesome invasive plants in North America is a non-native perennial grass called *Phragmites australis* (common reed). Its rapid expansion has devastated aquatic, wetland and riparian habitats throughout North America. Once established, *Phragmites australis* produces tall, dense monocultures which displace native species, reduce biodiversity and negatively impact wetland quality and function. This project will investigate new and improved chemical control strategies to manage *Phragmites australis* populations for the purpose of restoring native wetland habitats in the Great Lakes region.

This work focused on the utilization of new herbicides recently approved by the U.S. Environmental Protection Agency for aquatic environments. The project objectives are to: determine the most effective herbicide and/or herbicide combinations against *Phragmites australis*; identify appropriate rates and timing of application; and assess the value of combining herbicides with other control methods (mechanical or cultural) as an integrated weed management approach. The project will also examine beneficial approaches to the establishment of native plant communities that were displaced by *Phragmites australis*.

Identifying new and improved management strategies against *Phragmites australis* will reduce the invasiveness and spread of this noxious weed, improve wetland quality and function, restore native wetland habitats, increase plant and animal biodiversity, and minimize impacts to threatened and endangered wetland species.

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A Case-study Comparison of Two Indices for Ranking Ecosystem Restoration Projects Based on National Benefit

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Compliance with the Government Performance and Results Act requires most Federal agencies, including the U. S. Army Corps of Engineers (USACE; Corps), to annually rank activities based on their improvement of national welfare. The Corps ranks its ecosystem restoration projects for feasibility study and implement-ation funding using two forms of a metric based on relative significance of restored ecological resources. This resource significance index (RSI) is dominated by habitat considerations, which also predominate in project planning, but the RSI differs conceptually from the many different metrics used for project planning. Universally applicable metrics would have definite advantages.

The Biodiversity Security Index (BSI) was developed to establish a common project and program basis for benefits measurement, and to address other needs. One critical project-planning need is a metric that indicates the long-term sustainability of the desired output. The BSI indicates the significance of ecological resources targeted for restoration based on species sustainability and distinctiveness, and the risk of species failure to become established. Instead of habitat units, the BSI form recommended for project planning and implementation ranking uses a viable population unit as the basis for incremental cost analysis and plan comparison. A simpler form is used to rank feasibility studies based on the species sustainability and distinctiveness alone. Data in the conservation database NatureServe Explorer are used to calculate the BSI. Scores are calculated for each indicator species in the vicinity of the restoration problem and then summed.

A case-study comparison of the BSI and RSI was recently completed to assess differences in ranking feasibility studies at 24 project sites selected to represent a wide range of size and ecological conditions. BSI score variation was influenced by three variables: the total number of species that are moderately to highly vulnerable to extinction, the level of species security from extinction, and the species distinctiveness as indicated by the number of American species in their taxonomic family. The correlation of log-transformed BSI and RSI scores explains half of the variation ($R^2 = 0.50$). Project area size and resource scarcity explains much of the positive correlation. Score differences probably result largely from the emphasis placed on habitat scarcity by the RSI and species scarcity by the BSI. Ranking issues are addressed for both metrics.

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Improving Implementation and Effectiveness Monitoring at Dam Removal Sites and Their Integration with Project and Program Planning

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The NOAA Restoration Center provides funding and technical assistance for dam removals in watersheds with sea-run fisheries and in Great Lakes watersheds. Fish passage and aquatic habitat restoration are primary agency objectives. To better document how well projects are being constructed and meeting basic project objectives, NOAA has developed systematic implementation monitoring that is required for all NOAA-funded dam removal projects. We also want to better understand project effectiveness and thus we are building a long-term monitoring program for detailed evaluations of a subset of projects. Our long-term effectiveness monitoring program is being developed around regional networks of sites that are chosen to represent the range of habitat types and scales typically used by NOAA trust resources in the region, and to address specific questions of regional importance. In most cases, the research questions, and subsequent data collection and analyses, are ecologic recovery-oriented. But many of our research questions and results also directly address implementation issues. For example, sediment volumes deliberately discharged from a breached impoundment are often temporarily stored in low gradient downstream reaches. Monitoring that investigates the rates at which these sediments are remobilized from the downstream reach will improve our understanding of the potential impacts on stream biota. Such monitoring will also provide project proponents working in similar environments with information useful for permittees and abutting landowners. Here we summarize our nationwide implementation monitoring program for dam removal sites and report on our recent experience developing a long-term effectiveness monitoring program for dam removals in the Northeast United States, which may provide a useful framework for similar monitoring networks in other regions. We also describe our efforts to better integrate restoration monitoring with project and program planning to ensure that what we learn from project monitoring informs future restoration activities.

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Integration of Science and Engineering into innovative Ecosystem Restoration Concepts for the CERP C-111 Spreader Canal Western Project

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The C-111 Spreader Canal (C-111SC) Project lies along the southeastern portion of the Everglades and Florida Bay in an area that is heavily influenced by the Flood Risk Management system of the Central and South Florida Project. The dynamic and complex interactions between man and the environment in this intensely managed system create difficult challenges. Minor adjustments to hydraulic flow affect both surface and groundwater, and can have major implications on freshwater hydroperiods and nearshore salinities. As such, a robust incorporation of Adaptive Management (AM) principles has been crucial to the modeling and design of a cost effective and successful restoration project.

During initial planning for the Project, several critical uncertainties were identified that could acutely delay project implementation and have profound effects on restoration potential. A decision was made to incorporate incremental adaptive management, separating the project into two increments that would be planned and implemented in succession. The first increment, the C-111 Spreader Canal Western Project (Western Project), will consist of flexible elements and exploratory designs that can be modified or adjusted to achieve optimal performance. The second increment, the C-111 Spreader Canal Eastern Project (Eastern Project), will build on these advancements by utilizing data and trends obtained from the analysis of project operations and ecological response.

The main restoration features of the Western Project are two above-ground “Water Detention Areas” that will employ an engineering concept known as a hydraulic ridge. The hydraulic ridge will be formed between the C-111 drainage canal and Everglades National Park, rehydrating natural sloughs in the Park and returning vital freshwater flow to Roseate Spoonbill foraging and nesting areas. The magnitude and duration of the hydraulic ridge is highly flexible and can be controlled to balance water levels across the project area, which is necessary for future implementation of the Eastern Project. Additionally, an Active AM strategy is being employed through a Spreader Canal Design Test that will furnish data for the design of the Eastern Project. A non-intrusive, temporary Spreader Canal and monitoring network has been constructed on project lands. Numerous hydration scenarios are being conducted to determine proper Eastern Project Spreader Canal sizing, alignments and operational durations. Other Adaptive Management features being employed by the C-111SC Western Project will focus on incremental adjustments to operations at existing water management structures, rehydrating wetland areas while avoiding any potential flooding in adjacent agricultural lands. The results will provide immediate wetland restoration and system responses that can be used to predict complete drainage canal backfill alternatives for the Eastern Project.

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Special Session: Principles and Guidelines for Water Resources Planning and Implementation

Tab Brown¹, Bruce Carlson¹ and Cliff Fitzsimmons² – presented by **Robyn Colosimo**

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The White House Council on Environmental Quality (CEQ) is undertaking revisions to the Principles and Guidelines (P&G) that guide Federal water resource implementation studies and that affect all Federal agencies implementing water resource projects. Revisions include four major principles that modernize the current approach to water resources development in this country. (1) Achieving Co-Equal Goals: Federal water resources planning and development should both protect and restore the environment and improve the economic well-being of the nation for present and future generations. While the 1983 standards emphasized economic development alone, the new approach calls for development of water resources projects based on sound science that maximizes net national economic, environmental, and social benefits. (2) Considering Monetary and Non-Monetary Benefits: Consider both monetary and non-monetary benefits to justify and select a project that has the greatest net benefits – regardless of whether those benefits are monetary (e.g., reduced flood damages measured in dollars) or non-monetary (e.g., biodiversity benefits). (3) Avoiding the Unwise Use of Floodplains: The decision to modify water resources and floodplains will be based on evaluations of the services gained and lost by such an action. Evaluations must give full and equal consideration to nonstructural approaches that can solve the flooding problem without adversely impacting floodplain functions. (4) Increasing Transparency and "Good Government" Results: Promote transparency of the planning and implementation process for water resource development, and deliver "good government" results for the American people. It is expected that the use of best science, peer review, and full transparency will ensure that projects undergo a more rigorous study process, which should inform authorization and funding decisions.

The session will address the process of revising the P&G; policy, science and engineering issues; and emerging procedural guidelines and methodologies. A series of short presentations will be made by a panel of agency experts covering: (1) history of the principles and guidelines and proposed changes; (2) response to the CEQ's proposal; (3) review of emerging procedural guidelines and major policy challenges; (4) major technical challenges and opportunities; and (5) anticipated next steps. Panel presentations will be followed by an open forum for questions and answers. The session is intended to offer a forward-looking perspective that will be of interest to water resource planners, engineers, managers and researchers alike. Ensuing discussion will be relevant to virtually anyone working in or affected by federal water resources planning, policy development, operations and research.

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Relocation a Way of Life

Sharon W. Conklin

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The Uniform Relocation Assistance & Real Property Acquisition Policies Act of 1970 (as amended, 1987), P.L. 91-646 provides that residents who are displaced by Federal or Federally-assisted projects are entitled to relocation assistance, including moving costs and relocation to comparable decent, safe and sanitary housing. Displaced businesses are also entitled to certain benefits and assistance. In ecosystem restoration projects the Act's requirements can present unique challenges with little contextual precedence or guidance on how to effectively meet those challenges. This presentation involves identifying some of the potential relocation issues along with suggestions for resolving them based on lessons learned in projects associated with the restoration of the Everglades.

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Analyzing the Effects of the Hydroelectric Plant Releases on the Hydrology of the Congaree National Park Floodplain, South Carolina

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The Congaree National Park was established “...to preserve and protect for the education, inspiration, and enjoyment of present and future generations an outstanding example of a near-virgin, southern hardwood forest situated in the Congaree River floodplain in Richland County, South Carolina (Public Law 94-545).” The resource managers at Congaree National Park are concerned about the timing, frequency, magnitude, and duration of floodplain inundation of the Congaree River. The dynamics of the Congaree River directly affect groundwater levels in the floodplain and the delivery of sediments and nutrients is constrained by the duration, extent, and frequency of flooding from the Congaree River. The Congaree River is the southern boundary of the Congaree National Park and is formed by the convergence of the Saluda and Broad Rivers 24 river miles upstream from the park. The Broad River basin is approximate twice the size of the Saluda River basin (5,310 and 2,500 square miles, respectively). The flow of the Saluda River has been regulated since 1929 by the operation of the Saluda Dam at Lake Murray. The U.S. Geological Survey, in cooperation with the National Park Service, Congaree National Park, studied the interaction between surface water in the Congaree River and groundwater to determine the effect Saluda Dam operations have on water levels of the Congaree National Park floodplain.

Analysis of peak flows in this study showed the reduction in peak flows after the construction of Lake Murray was more a result of climate variability and the absence of large floods after 1930 than the operation of the dam. The analysis for this study showed that dam operations reduced the recurrence interval of the 2-year to 100-year peak flows by 6.1 and 17.6 percent, respectively. Analysis of the daily gage height of the Congaree River showed that the dam has had the effect of lowering high gage heights (95th percentile) in the first half of the year (December to May) and raising low gage heights (5th percentile) in the second half of the year (June to November). The dam has had the effect of increasing the 1-, 3-, 7-, 30-, and 90-day minimum gage heights by up to 23.9 percent and decreasing the 1-, 3-, 7-, 30-, and 90-day maximum gage heights by up to 7.2 percent. Analysis of the groundwater elevations in the Congaree National Park floodplain shows similar results as the gage-height analysis – the dam has had the effect of lowering high groundwater elevations and increasing low groundwater elevations. Overall, the operation of the dam has had more of an effect on the gage heights within the river banks than gage heights in the floodplain. This result may have a larger effect on the subsurface water levels of the surficial floodplain aquifer than the frequency and magnitude of inundation of the floodplain.

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Rethinking Instream Structures

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Various instream structures have been developed and adapted in the past several decades that play various roles in streambank and channel stabilization, flow diversion, river restoration, fish passage, and such other goals as whitewater recreation features. The use of these structures in varied settings has relied on assumptions and claims that are often unsupported by data, that are characterized by shallow or self-reinforcing logic, and that do not consider alternative techniques or a full suite of biotic and ecosystem implications. This presentation addresses the history of vane and weir structures, their applications for various goals, and their effects on hydraulic properties, geomorphic processes and condition, aquatic and riparian habitat, and habitat utilization. Developing techniques in constructed riffle design will be presented. New trends in fish passage toward tools like roughened ramps and nature-like fishways will be discussed in the context of converging assessment of natural form and system analogs, behavioral and ecosystem issues, and evolving design and validation tools.

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Threshold Concepts in Ecosystem Restoration Benefits Assessment

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Theoretical ecosystem ecology has moved in recent decades away from linear, single equilibrium state models of ecosystem behavior to an increased recognition of roles of disturbance regimes, the importance of dynamism, and the investigation of thresholds and multiple meta-stable states through state-and-transition modeling. This is far less true of restoration practice, which has largely failed to address even simple physical threshold phenomena, not to mention the more complex thresholds present in community dynamics and those involving interactions between biotic and abiotic ecosystem components. Much of the logic, both explicit and implicit, underlying restoration and ecosystem management assumes linearity of response to an action or change, either beneficial or destructive, relative to ecosystem integrity, normative ecosystem function, native biodiversity, and related targets. Managers, planners, and practitioners of ecosystem restoration should be aware that this is often an incorrect assumption with potentially significant consequences. Benefits can accrue (or be lost) in a stepped fashion due to the influence of abiotic and biotic thresholds, significantly complicating the assessment and quantification of environmental benefits. Furthermore, the crossing of critical thresholds can lead to sudden changes in state or process trend—possibly pushing the system toward an entirely new, unanticipated equilibrium. Personnel tasked with planning, executing, and implementing adaptive management for ER projects and programs need to be aware of and develop means of addressing thresholds and their roles. Though capabilities for predicting threshold levels are currently limited, conceptual and simple probabilistic quantitative methods will be presented.

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EverVIEW: Bringing Ecological Modeling, NetCDF Data Manipulation and Visualization to the Natural Resource Manager's Desktop

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Natural resource managers in the Greater Everglades have expressed their need to view and manipulate ecological modeling data on their desktop computers. Managers not only want to view model output on their desktops, but also to run ecological models, adjust model parameters when assessing alternative restoration plans, and have a spatially explicit visualization environment for comparing these alternatives. Working through the USGS Priority Ecosystem Science (PES) program, the National Wetlands Research Center has created **EverVIEW** to help address the needs of resource managers.

EverVIEW is a desktop application developed in Java for multiple operating systems. The application was designed in a framework which facilitates deploying functionality as tools or plug-ins. **EverVIEW** exposes tools to the user through various toolboxes such as the Data Manipulation Toolbox and the Modeling Toolbox. Tools can be incorporated into **EverVIEW**, the umbrella application, or downloaded and run as stand-alone executables.

The Greater Everglades modeling community is progressively moving to NetCDF as the default data container for modeling inputs and outputs. **EverVIEW** is designed to view NetCDF data in a spatially-explicit environment but also allows the user to view other local or web mapping service (WMS) enabled spatial datasets. The "NetCDF Slice & Dice Tool" from the Data Manipulation Toolbox was the first tool released. This tool allows the end-user to create subsets of NetCDF files through user-defined filters. Users can filter data using desired date ranges, seasons, spatial envelopes or polygon geometry, and other ranges of data values.

A unique feature of **EverVIEW** is an ability to instantiate multiple mapping panels, each of which can be populated with different datasets allowing the end-user to spatially compare modeling inputs and outputs. Users are able to download models from the Modeling Toolbox and view inputs and outputs on map panels arranged on the screen simultaneously. For example, after downloading the spoonbill habitat model, users can choose to view salinity, water depth and nest location inputs in separate map panels, and the resulting habitat suitability output in another panel.

The Greater Everglades management community can finally perform side by side model comparisons on their desktops using that information to make better informed decisions. **EverVIEW** will continue to evolve to maintain its relevance in meeting the needs of natural resource managers.

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Acceptance of the Mississippi River Healthy Watersheds Initiative by Land Managers in the Yazoo Basin

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The Mississippi River/Gulf of Mexico Hypoxia Task Force and the Gulf of Mexico Alliance both have Action Plans that call for the reduction of nutrients to the Gulf of Mexico. The Mississippi Department of Environmental Quality and Delta F.A.R.M. co-lead an effort to develop the Delta Nutrient Reduction Strategy in 2009 to reduce nutrient loading into the Mississippi River from the Yazoo Basin. As a part of the strategy, a comprehensive implementation plan was developed to reduce nutrients from all sources, especially from agricultural non-point sources. Numerous resources were identified as potential sources to fund the implementation of this strategy. Among those resources, Mississippi River Basin Healthy Watershed Initiative (MRBI) has become the most significant and will certainly provide the most significant contribution toward the reduction of nutrient loading in the Mississippi River from within the Yazoo Basin.

A coalition of conservation organizations and natural resource agencies has been successful in securing five major MRBI projects in the Yazoo Basin. Among the successful proposals, there are three MRBI Cooperative Conservation Partnership Initiative in three different 8-digit HUCs in the Yazoo Basin. This includes a \$12.3 million proposal for the Sunflower River Watershed, \$3.5 million proposal for the Deer Creek-Steele Bayou Watershed and \$2 million for the Upper Yazoo Watershed. All funds secured through the MRBI Cooperative Conservation Partnership Initiative in the Yazoo Basin will be spent on the installation of Best Management Practices that reduce nutrient loading from agricultural lands through Environmental Quality Incentives Programs cost-share agreements. A MRBI Conservation Innovation Grant was also secured to further support other MRBI activities in the Yazoo Basin. Lastly, a MRBI Wetland Reserve Enhancement Program proposal was approved for a total of \$13.8 million.

After nearly two years, the Mississippi NRCS has successfully administered authorized MRBI funds in approved watersheds with overwhelming support from private landowners and conservation organizations. In fact, requests for projects have continued to substantially outpace MRBI and other funding sources for nutrient reduction Best Management Practices in the region.

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Partnerships Driving Ecosystems Restoration on Private Lands in the Yazoo Basin

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There is a rich history of private lands conservation and the efforts of private landowners to conserve, enhance and restore the natural and wildlife resources on individual properties within the Yazoo Basin. However, the establishment of several regional-focused conservation and wildlife organizations helped create a more comprehensive and coordinated approach to natural and wildlife resource conservation and restoration in the Yazoo Basin. With the support of private landowners, many of these regional-focused NGOs have been able to establish strong partnerships with state and federal agencies to expand existing conservation initiatives and establish new initiatives that have become models for comprehensive ecosystem restoration in agricultural landscapes.

The Mississippi Partners for Fish and Wildlife was one of the first private-public partnerships that employed a comprehensive approach to ecosystem restoration on wetlands in the Yazoo Basin. USDA's Wetland Reserve Program soon followed suit. And while wetlands were the main focus of these earlier initiatives, the programs helped lay the foundations for how the support of private landowners and private-public partnerships could be used in the region to address natural resource concerns.

Similar private-public partnerships were established in the late 1990's in response to surface water quality concerns identified by the 303(d) list of impaired streams. While water quality was the driver, these partnerships developed Comprehensive Watershed Restoration Plans that addressed multiple resource concerns within particular watersheds in the Yazoo Basin. Many such plans quickly found funding for implementation and have since achieved nearly every objective and goal set forth by those plans.

The most recent private-public partnership has been used to develop the Delta Nutrient Reduction Strategy, a comprehensive approach to nutrient load reduction within the Yazoo Basin. This plan, as called for by the Mississippi River/Gulf of Mexico Hypoxia Task Force and the Gulf of Mexico Alliance to address Gulf Hypoxia, has been the most successful, comprehensive, and diverse ecosystem restoration effort undertaken by the region.

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A Landscape Assessment of Nutrient Loading Potential to the Chesapeake Bay from Army Installations

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The Chesapeake Bay Action Plan of the U.S. Army has a goal of reducing the export of nutrients and sediments from Army installations to comply with a basin-wide TMDL. To rapidly evaluate non-point contributions from both natural and human-driven sources across a broad landscape, we combined the critical source area (CSA) concept with a geospatial approach (GIS). Using this approach, we identified those areas on Army installations that are most likely to contribute to nutrient export.

When excessive soil or land surface nutrient concentration coincides with a site of high potential runoff, i.e., a hydrologic variable source area (VSA), the result is a “Critical Source Area (CSA). Digital elevation, hydrography, soils, and landcover/use data were used to delineate CSAs and VSAs on Marine Corps Base Quantico (MCBQ) and topologically relate the CSAs to water quality impaired stream reaches. The method was then applied to Fort Belvoir to verify function, ease of application, and interpretations.

Spatial patterns at MCBQ and Ft. Belvoir differed substantially. At MCBQ about 20% of the land is in VSAs and these lie predominantly along higher order tributaries of the Potomac. Similarly, at Ft. Belvoir, VSAs are about 17% of the total land area. However, the Ft. Belvoir streams drain almost directly to the Potomac River (via first or second stream order relationships), with greater potential to export nutrients compared with MCBQ. The distribution of CSAs is also markedly different. At MCBQ, CSAs are only about 3% of the total land area (13% of the VSAs), but are nearly double that at Ft. Belvoir (5% of total and 31% of the VSAs).

As might be expected, the fraction of land with low nutrient export potential (based on land cover) shows the reverse pattern. At MCBQ about 17% of the total land (85% of the VSAs) is in “natural background” areas with low potential export, whereas at Fort Belvoir this is reduced by about half, with only 8% of total land area (47% of VSAs) in the low-yield category.

The CSAs identified with this approach may serve as priority targets for management actions that reduce nutrient export. We are now expanding our analysis to all the Army installations within the Chesapeake drainage, and will incorporate our results into a user friendly decision support system. This method can be readily exported to other regions.

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Harvesting Macroalgae as a Means of Reducing Nutrients in Jamaica Bay, New York City

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Through the Jamaica Bay Watershed Protection Plan (JBWPP), the New York City Department of Environmental Protection (DEP) collaborated with other agencies to develop an interagency action plan for ecological restoration and water quality improvement of the bay. Most of Jamaica Bay lies within the Gateway National Recreation Area, which was the first national urban park, and remains an important natural feature in the NYC metropolitan area. The JBWPP includes implementing environmental pilot projects, such as the Sea Lettuce Harvesting pilot project, which will assess water quality benefits and provide case studies to guide future development practices in Jamaica Bay. The Algae and Sea Lettuce Harvesting pilot project has evaluated benefits to harvesting excess macroalgae and sea lettuce (*Ulva lactuca*), which can improve nitrogen concentrations, aesthetic qualities, and produce biofuel.

Annually, Jamaica Bay experiences recurring blooms of sea lettuce, and the excessive overgrowth of macroalgae often forms thick, detached mats which accumulate along shorelines and in shallows. As these algal mats decompose, depletion of oxygen in the overlying water causes stress to many aquatic organisms, and decomposition along intertidal shorelines and beaches produces noxious odors. During 2010, DEP conducted two macroalgae harvests in areas of accumulation within Jamaica Bay using skimmer boats specially designed to remove floatable debris from NYC waters. The results of the macroalgae removal and monitoring effort will be presented as well as the City's proposed plan for continued removal of macroalgae blooms.

DEP is conducting this pilot project in conjunction with maintenance and infrastructure improvements to sewer and treatment facilities in Jamaica Bay, which have the potential to greatly reduce nitrogen and phosphorus inputs, the stressors causing eutrophication.

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Working towards Nutrient Reduction in a Eutrophic Urban Estuary: Ribbed Mussel Biofiltration in New York City's Jamaica Bay

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The Jamaica Bay Watershed Protection Plan developed by New York City Department of Environmental Protection (DEP) is an interagency action plan for ecological restoration and water quality improvement of the Bay. Jamaica Bay lies mostly within the Gateway National Recreation Area, the first national urban park and an important natural feature in the metropolitan area. The JBWPP includes implementing environmental pilot projects, such as the Ribbed Mussel Biofiltration pilot project, which will assess water quality benefits and provide case studies to guide future development practices in Jamaica Bay.

The goal of the Ribbed Mussel Biofiltration pilot is to successfully use ribbed mussels to filter wastewater treatment plant effluents, and stormwater/CSO discharges to remove suspended particulate matter and nutrients, and thereby improve water quality in Jamaica Bay and its tributaries. The study, which is permitted and will be constructed in early 2011, includes testing alternative surfaces (gabion baskets, netting, and expanded metal sheets) to maximize natural settlement and growth of ribbed mussels in a tidal creek. Ribbed mussels, which are common in Jamaica Bay, remove suspended nutrients and particulate matter without creating an attractive nuisance, such as restored oyster reefs do. The results of the pilot project's first monitoring season and initial design criteria recommendations for expanded facilities will be presented.

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Central and Southern Florida: West Palm Beach Canal (C51) STA 1-East improvements, an Examination of Project Implementation and Performance Issues

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The West Palm Beach Canal (C-51)/Stormwater Treatment Area (STA) 1E project was authorized under the Flood Control Acts of 1948, 1954, 1962, 1968, and the Water Resources Development Act (WRDA) of 1996. The project is located in Palm Beach County and runs east/west from West Palm Beach at Lake Worth to Water Conservation Area (WCA) No. 1 (Loxahatchee National Wildlife Refuge). The authorized project will provide 30-year flood protection to the urbanized eastern basin and 10-year flood protection to the western basin. All eastern basin features have been completed. During mediation of the Everglades water quality litigation, a technical plan was developed for resolution of the litigation. The technical plan included a substantially modified C-51 project. The modified plan expands the original 1,600-acre floodwater detention area into a 6,500-acre stormwater detention area. In addition to the flood damage reduction benefits provided by the original project, the modified plan provides water quality treatment, reduction of damaging freshwater discharges to Lake Worth, and increased water supply for the Everglades and other users.

Section 315 of The Water Resources Development Act of 1996 reads as such:

“The project for flood protection of West Palm Beach, Florida (C–51), authorized by section 203 of the Flood Control Act of 1962 (76 Stat. 1183), is modified to provide for the construction of an enlarged stormwater detention area, Storm Water Treatment Area 1 East, generally in accordance with the plan of improvements described in the February 15, 1994, report entitled “Everglades Protection Project, Palm Beach County, Florida, Conceptual Design”, with such modifications as are approved by the Secretary. The additional work authorized by this section shall be accomplished at Federal expense. Operation and maintenance of the stormwater detention area shall be consistent with regulations prescribed by the Secretary for the Central and Southern Florida project, and all costs of such operation and maintenance shall be provided by non-Federal interests.”

The STA 1 East and C-51 improvements were completed and transferred to the sponsor in October 2005. Several culverts within the STA have failed. Repairs to three culverts have been implemented by Jacksonville District. Funding is being sought to address the other issues. This presentation will examine the implementation of the STA 1-E project modifications and the performance of the STA.

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Successful Invasive Species Management Activities in 8.5 SMA, A Modified Waters Delivery Restoration Project

Joanna M. Savinon, **Jeremy M. Crossland**, Angie L. Huebner, Jon M. Morton and Jon S. Lane
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A primary issue in restoration projects existing infestations of invasive species and encroachment of invasive species during the construction/restoration process. Invasive flora and fauna cause negative impacts to restoration projects by negatively impacting natural landscape and the flora and fauna that utilize the lands. In addition invasive species can negatively impact the functionality of the project including water storage, flood risk management, and water quality. The Jacksonville District recognized that Brazilian pepper, Melaleuca, and other invasive species present in the area would negatively impact the results and goals of the project.

The Jacksonville District took action and utilized a contractor to treat and remove the invasive vegetation from the project. The treatment was successful and continues to aid in the restoration of the project.

The initial treatment of invasive flora, which started in May 2009, was completed by 12 September 2009. Follow up treatments are scheduled for early 2011. The initial treatment required 36,000+ man hours performed by a 60-man crew. Only one minor injury occurred. Treatment included 19 FLEPPC Category 1 and Category 2 invasive species. The following species were most prevalent in the project footprint:

Melaleuca quinquenervia

Brazilian Pepper: *Schinus terebinthifolius*

Australian Pine: *Casuarina spp.*

Luziola subintegra

Wedelia trilobata

Napier grass: *Pennisetum purpureum*

Silk grass: *Pityopsis graminifolia*

Lessons Learned in the management process included: The cost of the exotic vegetation management project increased due to a significant delay between the development of the scope of work (SOW) and award of the contract. In the case of 8.5 SMA, aerial and ground surveys were conducted to identify treatment needs. The information was used to develop the SOW and independent government estimate (IGE). Seven months passed between the initial surveys and the contract award. During this period, vegetation continued to grow and the infested areas expanded in acreage, increasing the cost of treatment.

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U.S. Army Corps of Engineers Moves toward Improved Invasive Species Management Practices

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A primary issue in restoration projects and maintenance of natural areas in landscapes across the United States is the encroachment of invasive species. Invasive flora and fauna cause negative impacts to restoration projects, natural landscapes, and endangered species every year. The US Army Corps of Engineers (USACE) has recognized this issue and created new policy to guide all agency activities and ensure improved and standardized invasive species management across projects.

The USACE recognized the need for standardized practices across the agency. Additionally, the development of the policy will assist with compliance to Executive Order 13112 and will reduce operations and maintenance costs related to invasive species management.

The USACE's goals include creating a center of expertise, standardizing management activities, expanding research, and improving public outreach. The center of expertise (CX) will consist of a leadership team, panel of agency experts, and a headquarters proponent. The goals of the CX include establishment of an early detection rapid response team and standardization of management practices across the 45 districts. The leadership team provides support to the field and develops policy and direction for the USACE's invasive species program. The headquarters proponent will assist and support both the leadership team and CX with invasive species issues including policy development/guidance and updating regulations.

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Techniques and Tools for Designing, Funding, Implementing, and Managing Large-scale, Long-term Ecosystem, Watershed, and/or Fishery Restoration Programs

Storm Cunningham

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When ecosystem and natural resource restoration projects reach certain geographic sizes and/or chronological lengths, challenges can arise that are minor or non-existent at smaller/shorter scales. Some of these factors—such as restoring links among isolated ecosystems—are within the expertise and comfort zone of practitioners.

Other challenges that emerge at large/long scales are outside both the expertise and comfort zone of most ecosystem restoration practitioners, and might require the use of unfamiliar tools that were unnecessary at smaller scales. Most ecosystem restoration practitioners are not equipped—and are often not willing—to address overlapping or conflicting renewal agendas. These include—but are not limited to—heritage restoration, agricultural revitalization, infrastructure renewal. Many of these agendas affect ecosystems, or are affected by them. Some agendas, such as infrastructure renewal, can be key to technical ecosystem restoration success. Other agendas are extrinsic, but can prevent the approval or success of the ecosystem project/program if not effectively addressed.

Such constraints generally fall into two categories: 1) integrating the renewal of the natural, built, and socioeconomic environments, and 2) engaging all the stakeholders—private landowners, citizens, businesses, government, non-profit, and academic—needed to design, fund, or implement the restoration program.

A method has been developed that addresses both of these complex challenges at the community, regional, and even (theoretically) national scales. Moreover, a software tool has been developed to make this complexity more manageable.

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Restoring the Anacostia River Watershed

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The Anacostia River is a tributary of the Potomac River that flows through historically developed areas of Montgomery and Prince George's Counties in Maryland and parts of urbanized southeast Washington, D.C., before flowing into the Chesapeake Bay. More than 860,000 people live in the 176-square-mile Anacostia watershed, and problems with water quality, habitat loss, and impaired ecosystem functioning have been well documented.

The Anacostia Restoration Plan (ARP) is the product of a 2-year effort to develop a systematic 10-year plan to restore the entire Anacostia River Watershed. Over the years, intense urbanization of the watershed has increased runoff volume and velocity, reduced groundwater recharge, diminished water quality, and degraded riparian areas and aquatic habitat. The ARP was developed as a holistic plan to address the watershed's problems comprehensively – bringing many independent restoration actions into one coordinated plan of action.

The Project Delivery Team developed the ARP in stages: (1) desk-top GIS exercises to identify potential restoration opportunities, (2) field work to identify site-specific information, (3) watershed modeling, (4) project scoring and ranking, and (5) grouping projects in clusters to focus attention on stormwater management improvements. The final products of the ARP include an Existing Conditions Report and an Action Plan for the entire Anacostia watershed, as well as a separate Existing Conditions Report and an Action Plan for each individual subwatershed and tidal reach. The inventory includes more than 3,000 projects to be implemented at all levels, public and private.

One of the most important elements in the success of the ARP was the amount of interagency, intergovernmental, and public coordination undertaken throughout the life of the project. The Metropolitan Washington Council of Governments was a partner from the start, and the Anacostia Watershed Restoration Partnership included both a Management Committee and a Steering Committee. Committee members represented Federal, State, and local agencies with an interest in the watershed, as well as technical experts from local universities, think-tank and non-profit organizations, private developers, and others. In addition to working with these academic, corporate, and government partners, the success of the project depended on extensive interactions and engagement with local residents, citizen advocates from each subwatershed and tidal reach, and the Anacostia Watershed Society (formed in 1989 to advocate for the restoration and protection of the Anacostia watershed). This extensive collaboration among project partners and local watershed groups resulted in across-the-board acceptance of the ARP as soon as it was unveiled in April 2010. Because partner and public support for the project had been secured incrementally throughout the 2-year planning process, there was no public controversy when the final plan was released. Instead, almost immediately, stakeholders began implementing projects and recommendations identified in the ARP.

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Ecosystem Restoration of the Salt River, Va Shly 'ay Akimel

Chris D'Arcangelis

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The U.S. Army Corps of Engineers (USACE) is spearheading the effort for eco-restoration of the riverine environment of the Salt River in Arizona. A series of projects have been implemented to transform the much overused riverbed and floodplain back to its natural state. Beginning at the confluence with the Gila River, the Salt River restoration project includes: Tres Rios – 7 miles, Oeste – 8 miles, Rio Salado - 4.5 miles, and Va Shly'ay Akimel - 9 miles.

The Rio Salado project has been completed and a significant portion of the Tres Rios project is scheduled for completion in 2012. Both the Oeste and Va Shly'ay Akimel projects are in various design development stages. The Va Shly'ay Akimel eco-restoration project is a joint effort involving the partnership of the Salt River Pima Maricopa Indian Community, (SRPMIC), the City of Mesa, Arizona and USACE.

Va Shly'ay Akimel has been divided into three phases; the first phase is nearing the end of plan development and will soon be solicited for construction. Phase 1 is a 2.5-mile stretch from approximately 1-mile upstream of Tempe Town Lake eastward to McKellips Road.

The Roosevelt Dam, located 50 miles upstream from Phoenix, was completed in 1911, drastically altering the downstream natural environment which is dependent on the perennially flowing Salt River. Taming the river with this dam provided flood control but severely changed the ecology downstream. Nearly all native species perished to invasive species, allowing them to dominate the riverbed and floodplains. In addition, the riverbed became a prime source for sand and gravel companies to supply materials for the ever expanding metropolitan Phoenix area.

The Va Shly'ay Akimel project will restore the native wetland and riparian habitats that historically defined the Salt River ecosystem. It will restore a sustainable balance of flora and fauna through construction of a viable system of wetlands, channels, terraces, slopes, and water delivery and management systems to establish and nourish communities of native plants. Additional measures will be included to control invasive species. The project will re-establish the natural beauty of the Salt River and restore a sense of heritage for the Salt River Pima Maricopa Indian Community.

Phase 1 habitat restoration comprises 89 acres of cottonwood/willow, 58 acres of wetlands, 130 acres of mesquite woodland, 54 acres of upper Sonoran, 48 acres of river bottom-ephemeral, and 160 acres of open water.

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Wildland Soil Carbon Management

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In the era of climate change, traditional wildland management practices have come into question, especially with respect to their impact on soil carbon sequestration. Over half of the land area of the United States and Puerto Rico is either in forest or grassland ecosystems, i.e. 302 million hectares of forested lands and 247 million hectares of grasslands and pasture lands. Forested lands hold approximately 35.5 Pg of soil carbon to a depth of 100cm. Private grasslands hold approximately 21 Pg of soil carbon to a depth of 200cm. The difficulty of managing for carbon sequestration becomes more evident when one surveys the variety of complex ecosystems being managed. This presentation highlights implications for wildland forest management for promoting soil carbon sequestration for sustaining forested ecosystems in the United States. We will address key considerations, strategies, and opportunities to incorporate soil carbon management into wildland management. Examples of vegetation management influence on soil carbon will be discussed including fire, soil amendments and best management practices for maintaining and/or improving soil carbon sequestration. The USDA Forest Service has established a soil management policy that seeks to conserve soil quality and protect soil carbon on National Forest System lands. Aspects of this national policy will also be presented.

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Building with Nature: Nature Beyond Restoration

Huib de Vriend

EcoShape Foundation, Dordrecht, The Netherlands

Nature has long been considered as a good to be conserved and protected, a kind of museum object. This has often brought its proponents in conflict with parties striving for economic welfare and the infrastructure development needed for that. Building or working with nature takes a different approach: nature is given an active role in infrastructure development, in that the dynamics of the natural system are utilized to realize infrastructural goals. This is done in such a way, that the natural system itself gets new opportunities to develop. In this respect, it is a step beyond restoration.

The presently running Building with Nature innovation program in the Netherlands has the aim to scientifically underpin this concept and bring it to practical use. This requires research and expertise development in the interdisciplinary domain between technology, natural sciences and social sciences, or between building, nature and society. This is achieved via an interdisciplinary research program to fill a number of urgent knowledge gaps, by carrying out a number of small-scale pilot projects to build up experience, by connecting with a number of live infrastructural projects to introduce the ideas and build up expertise in applying them in real-life conditions, and by developing practical user guidelines and tools.

The paper will further outline the concept and report on the progress made so far. Clearly, long-term effects of the pilots and projects in the program cannot be reported yet, but there we can learn from earlier projects based on similar ideas. Examples of such projects will be given and analysed.

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Bay Delta Conservation Plan

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The Bay Delta Conservation Plan (BDCP). The BDCP was a joint Habitat Conservation Plan (to support take authorization under the Endangered Species Act) and Natural Communities Conservation Plan (to support take under the State Endangered Species Act) which laid the groundwork for a multi-billion dollar effort to ensure adequate water supplies and preserve the natural environment throughout the Bay Delta and California Central Valley. Fresh water reaching the Delta provides: 1) the core for the California water system, conveying drinking water to 25 million residents from the Central Valley through Southern California, 2) supports California agriculture, providing financial stability to the region that produces nearly half of the nation's domestically grown produce; and 3) supports the eighth largest economy in the world. The EIR/EIS had many challenges including complex modeling for one of the most altered riverine systems in the United States, coupled with navigating an even more complex regulatory maze. The analysis will model the future aquatic system (surface water, water supply, water quality and fisheries) over a 50-year plan including estimating the effects of future sea level change. The completion of the EIR/EIS had four co-lead agencies - California Department of Water Resources, Bureau of Reclamation, US Fish and Wildlife Agencies and National Marine Fisheries Service. In addition to the official lead agencies, coordination with numerous co-operating, responsible and trustee agencies were conducted.

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USACE Role in Creative Solutions to Water Shortages in Southern California: Connecting the Dots of Water Conservation, Environmental Infrastructure, and Local Groundwater Resources

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U.S. Army Corps of Engineers, Los Angeles, CA, USA

Panel Overview:

The Bay-Delta is California's hydraulic heart with very valuable, but fragile ecosystem, conveyance, and flood systems. Despite significant Federal spending and a comparable State share over the past 15 years, the ecosystem has continued to deteriorate. Continuation along the same path is not a viable option. The risks remain real – imperiled water supply for 25 million residents, scant irrigation water for 9 million acres of the nation's most productive farmland, and threatened critical energy and transportation infrastructure that supports the 8th largest economy in the world. In addition, there are fifty-five (55) ESA-listed species in the Delta. These risks transcend the California legal Delta boundaries, and they need to be considered as part of an overall system that encompasses natural and engineered waterways, regional environmental health, public safety, and national, regional and local economic livelihood. One must also consider the political context created as a result of Federal, State and local government responsibilities and the myriad of interested stakeholders.

Presentation Summary:

Mr. Ed DeMesa, Plan Formulation Branch Chief at the US Army Corps of Engineers Los Angeles District, will be the fifth speaker in a moderated panel discussion entitled "A Systems Perspective on Addressing Water Resources Challenges in the Sacramento – San Joaquin Bay Delta," providing the applied perspective.

Many communities in Southern California have initiated water conservation, recycling and environmental infrastructure programs to replace imported water demand with local sources of water for replenishment purposes, eliminating their demand for water imported from the Colorado River and the Bay-Delta. Projects that reduce demand reduce operational constraints and environmental stressors to the Bay-Delta. Under the Federal Bay-Delta Memorandum of Understanding, an Interim Federal Action Plan (IFAP) was developed to allow federal agencies to work together to "encourage the smarter supply and use of Bay-Delta water," intensifying and aligning Federal water conservation efforts with the State and affected communities and thereby reducing demand in targeted regions. Through the efforts of the water conservation and recycling interagency work group under the IFAP, and with the support of a USACE systems framework for Bay-Delta program development, USACE has made the case that while geographically distant and seemingly disconnected, creative solutions such as these can have a significant, positive influence on the Bay-Delta ecosystem.

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Evolution of Modeling Tools to Support Management and Restoration of the Great Lakes

Joseph V. DePinto, Todd M. Redder, Edward Verhamme and Tim Dekker

LimnoTech, Ann Arbor, MI, USA

The Great Lakes research and management community has a long history of developing and applying models as decision support tools for restoration and preservation of the Great Lakes Basin ecosystem. In the 1970s, a suite of models was used to establish target phosphorus load reductions to achieve and maintain trophic endpoints for each of the Great Lakes and several large embayments. In the 1980s the focus shifted to development of management strategies for persistent bioaccumulative toxic chemicals in the Great Lakes; and again whole lake mass balance and bioaccumulation models were used to guide the development of those strategies. Also, the fisheries management community used fish bioenergetics and population dynamics models to help understand the upper food web of each Great Lakes ecosystem and to support stocking and harvest decisions. The 1990s brought significant ecosystem structure and function changes to the Great Lakes as a result of non-indigenous species invasions. As a result of these changes and a need to make decisions at a more regional scale, models over the past 10-15 years have been developed and applied on a more local level to support these types of management decisions. We will present examples of three such case studies to illustrate this paradigm shift in decision making models and applications.

First, at the watershed scale, LimnoTech developed a hydraulic and sediment transport model for the lower Don River, an urban river in the city of Toronto, ON. The model was used to support the creation of a new river channel with natural meanders, wetlands margins, and abundant recreational opportunities. The redesigned river channel will simultaneously meet the City's needs for floodwater conveyance and residential, commercial, and industrial uses in the Don Lands area, while also addressing the community's strong desire to restore ecological function and recreation along the river.

At the Great Lakes tributary rivermouth scale, we have built a linked hydrodynamic – sediment transport – water quality model for the Lower Maumee River through the entire western basin of Lake Erie to support dredged material management for the navigation channel, including the potential use of material disposal for habitat creation. The model can also be used to quantitatively relate loading of sediments and nutrients to water quality endpoints in the western basin of Lake Erie, including the development of harmful algal blooms (*Microcystis sp.*) and turbidity at municipal water intakes.

Finally, at the lake scale, LimnoTech developed and applied an Integrated Ecological Response Model (IERM) for the Lake Ontario-St. Lawrence River system to simulate the effects of water level and flow regimes on key nearshore environmental performance indicators to be used to support the ecological interest portion of a shared vision model by evaluating alternative regulation plans for that system. This decision support tool included a model output visualization and analysis tool that used a "ratio" approach, which provided a summary score for each key ecological performance indicator.

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Dam Removal Impacts – Planning Considerations

Elvidio V. Diniz and Michael D. Smith

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Dam removal, either by design or unintentional failure, produces short term and long term impacts to both the upstream and downstream environments. There are numerous approaches to evaluate short term impacts, but long term channel evolution with and without the dam is not well understood or analyzed.

This presentation will look at the mechanics and consequences of dam removal from gradual reservoir evacuations to sudden failure by overtopping, erosion, piping or seepage. Procedures to remove sediment at the reservoir will be identified, and downstream hydraulic and floodplain changes will be evaluated, including increased risks of flooding, damage assessments and re-mapping of the floodplain. Other impacts, including fisheries, environmental, water quality and water supply/groundwater recharge will also be discussed.

Several examples will be presented to identify how these types of impacts were evaluated, and to illustrate how well the river system response was modeled both before and after the dam removal.

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Restoring Coastal Habitat in the Heart of New York City

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Jamaica Bay has evolved over the past 25,000 years as an important and complex network of open water, salt marsh, grassland, coastal woodland, maritime shrubland, and brackish and freshwater wetland habitat. The wildlife use of these systems is commensurate with this complex network of natural systems – the 20,000 acres of diverse habitat support seasonal or year round populations of over 214 species of special concern. Because of its geographic size and diverse habitats, Jamaica Bay is a nationally and internationally renowned birding destination.

However, the valuable resources that comprise Jamaica Bay are being lost. The current Jamaica Bay is only half of its pre-colonial extent. Filling, dredging, pollution, shoreline hardening, and other degradations have synergistically affected historic flow and sedimentation patterns in the Bay, eradicating natural habitat, impacting water quality, and modifying the rich ecosystem that was present prior to the extensive urban development of the watershed.

This presentation examines the overall context of restoration in Jamaica Bay and some of the restoration pilot studies that were first identified in the Jamaica Bay Watershed Protection Plan that are now being undertaken. The purpose of the pilot studies is to address uncertainties associated with technologies under NYC climate and environmental conditions to guide future practices, while attempting to aid efforts to restore and maintain water quality and ecological integrity. These pilot projects are unique in their exploration of sustainable approaches to address urban water quality and ecological concerns.

For example, eelgrass and oyster restoration studies are widely used elsewhere, but are new to the waters of NYC. Until recently, little attention has been paid to eelgrass and oyster enhancement and restoration in urban watersheds such as Jamaica Bay in waters that are closed to fishing and shellfishing. Over the past two years, we have been undertaking pilot projects within the Bay to restore eelgrass and oysters in Jamaica Bay, and will discuss the unique challenges of carrying out these projects, the lessons learned, and the direction for future efforts.

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Using Section 729 Watershed Assessments for Ecosystem Restoration in the Ohio River Basin

R. Gus Drum

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The Ohio River Basin is an ecologically-diverse hydrologic system covering 15 states and 528,357 square kilometers. Over 27 million people live within the basin and millions depend upon the basin's industrial capability and power generating capacity of the basin's 400 power plants. Over 2,600 incorporated communities and 548 counties administer various land use controls (or not) and programs for economic growth within the basin. Over 5 million people compete with the abundant aquatic resources of the Ohio River for potable water.

US Census projections for 2030 see another 3 million people added to the basin population – 3 million more people needing dwellings, transportation, sewer and water infrastructure, and producing more wastes that will need to be assimilated by an already over-stressed regional ecosystem. There are over 1,000 CSO's already identified by Ohio River Valley Sanitation Water Sanitation Commission (ORSANCO) along the Ohio River alone. Added to these existing stressors are the potential impacts of climate change to the basin's aquatic ecology.

The diversity of landforms and floral and faunal communities is exemplified by the presence of no fewer than 16 Level III eco-regions within the basin. The Cumberland and Tennessee rivers contain many threatened and endangered aquatic species and are world renown for their diversity and quality of ecosystem services. The Corps' 2009 Ohio River Basin Comprehensive Reconnaissance Study identified numerous issues including uncontrolled land cover change, deteriorating water quality due to non-point source pollution and nutrient loading, hydromodification and lack of stormwater management pose significant threats to the aquatic ecology of the region. Abandoned mine lands and other resource extraction techniques (hydraulic fracking for gas extraction) threaten the availability and quality of water in the basin.

Approval of the recommendations included in the 2009 Ohio River Basin Comprehensive Reconnaissance Report launched a series of five Initial Watershed Assessments at the sub-basin level each dedicated to assessment of opportunities to be found in the land and water related ecosystems. Each of the 5 watershed assessments is authorized by Section 729 of the 1986 WRDA as amended in the 2000 WRDA. Recent Corps guidelines for implementing the Section 729 watershed studies provide a broad spectrum of opportunities to investigate the resources and systems and to develop through collaboration with state, regional and local sponsors, management plans for each watershed. This presentation will look at this watershed assessment and management process and its prospects for resolving an array of pressing ecosystem problems.

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Picayune Strand Restoration Project in Southwest Florida: A Landscape Perspective and Interagency Effort to Restore Endangered Fauna, Wetland Habitat and Sub-Tropical Estuaries under the Comprehensive Everglades Restoration Plan

Kimberly A. Dryden

U.S. Fish and Wildlife Service, Naples, FL ,USA

The Picayune Strand Restoration Project is a 55,560-acre habitat restoration project located in the watershed the mangrove estuaries of the Ten Thousand Islands National Wildlife Refuge and Rookery Bay National Estuarine Research Reserve in sub-tropical Southwest Florida. Surrounded by Florida state parks and forests, the Florida Panther National Wildlife, Big Cypress Preserve and Everglades National Park; habitat restoration efforts will contribute to a complex of over 2 ½ million acres of contiguous public lands occupied by the Florida panther and Florida black bear. Freshwater wetland restoration will provide forage habitat for nesting wood storks at the largest historic wood stork rookery in the United States at Audubon's Corkscrew Sanctuary. Removal of point-source freshwater discharges to estuaries will improve critical habitat for the West Indian manatee and smalltooth sawfish. Hydrological restoration of wetlands should restore 30,000 acres of drained cypress forest and offer opportunities for restoration of rare bromeliads and orchids. The Comprehensive Everglades Restoration Plan provides an interagency framework for the Department of the Interior through the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, the South Florida Water Management District, and state and local partners to cooperatively fund, plan, construct, manage, and monitor a landscape-scale habitat restoration project.

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Challenges in Benefit Analysis and Project Justification

Dennis Duke

US Department of the Interior, Miami, FL, USA

The Comprehensive Everglades Restoration Plan (CERP) represents one of the largest ecosystem restoration projects in the world as well as one of the most challenging. The area of concern is huge covering the entire southern Florida peninsula from Orlando down through the Florida Keys, over 18,000 square miles. The \$13.5 Billion plan included over 50 projects to help restore the famed River of Grass and the fragile ecosystem that depends on that slow moving sheet flow of clean water. Although the plan was approved by Congress in 2000, it was not until 2007 before the first three major projects were fully authorized by Congress. Actual construction of these was then initiated in 2010. During the 7 year interval between initial approval and final authorization of the first 3 projects, some 15 project studies, called project implementation reports, were initiated to analyze and fully develop those projects as well as update their costs and benefits. To date, only three of those 15 have made it to Congress. Project after project ran into challenges as the Corps and project delivery teams tried to come to grips with the benefit analysis and the next added incremental justification needed for each project.

Currently, the Corps uses an evaluation method known as Habitat Units to determine the best alternative for the restoration project. Fundamental to this analysis is the identification of the important defining ecological characteristics and their restoration targets for the specific area to be restored and the assignment of the environmental lift to be achieved for these characteristics by implementing a particular alternative. This facilitates the comparison of the alternatives by reducing the total predicted benefits of each alternative to a single number. The alternatives are then subjected to an incremental cost and cost effectiveness analysis to determine the most cost effective alternative. With the use of extensive computer models, large areas can be analyzed quickly and the results again reduced to that single number for comparison. Unfortunately, there are problems with this approach in that the end result of the habitat analysis is that the environmental benefits are reduced to a single non descriptive and not ecologically meaningful number. Thus, an important environmental aspect of the project may not be properly considered in the final comparison, selection, and successful justification even though it was included in the initial matrix for analysis. Also, the results are obviously very dependent on the assignment of relative value to the importance of each restoration target by the team.

Other evaluation methods exist which offer advantages and disadvantages to the analysis, such as the Choosing By Advantages method used by the National Park Service. Each of these has their own issues and challenges. The purpose of this presentation is to provide an overview of the current benefit analysis employed, some of the issues and challenges with that methodology, potential optional methods, and to provide a more holistic look at the justification methodology and rationale for environmental restoration projects.

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Lake Rehabilitation Options for the Machado Lake Ecosystem Rehabilitation Project

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Eutrophication of Machado Lake, including the accumulation of toxic sediment, has degraded habitat, damaged water quality, reduced aesthetic value, and reduced the attractiveness for recreation. Machado Lake has deteriorated through excessive external and internal loading of nutrients, sediment, and trash. The Machado Lake Ecosystem Rehabilitation Project involves evaluation of lake rehabilitation options to improve the water quality conditions, aesthetic value, and the biological diversity of the ecosystem to attain and sustain desired uses/characteristics, and to create a healthy lake. Options considered appropriate to Machado Lake include sediment removal, supplemental water addition, off-line treatment wetland, oxygenation, phosphorus treatment, aquatic plant management and littoral zone enhancement, shoreline stabilization, floating islands, selected stormwater best management practices, in-lake sediment basins, and baseflow treatment. These options are predicted by the Lake Water Quality Model to reduce phosphorus concentrations in the lake by 85 percent, nitrogen concentrations by 34 percent, and chlorophyll-a by 77 percent. The goal of all improvements with regards to lake water quality is to reduce nutrient concentrations in the lake; remove toxic sediments; prevent excessive algal and *Ludwigia* biomass growth; and maintain adequate dissolved oxygen. An integrated suite of lake rehabilitation strategies will be implemented to address recycling of in-lake nutrient loads. Key components include dredging to an average depth of 8 feet and maintaining a constant lake water surface elevation by using a low nutrient supplemental water source. Recycled microfiltration/reverse osmosis (MF/RO) water will be used for lake augmentation purposes to maintain full lake levels in the summer. An offline-treatment wetland, an oxygenation system, and phosphorus removal system will also help satisfy the water quality objectives of the project. Each strategy must be implemented in concert with the others to meet water quality objectives and goals. An intensive program of invasive plant species removal will take place throughout the park. Invasive species like *Ludwigia* will be removed from the lake, while the Southern Tarplant and the Coastal Sage Scrub will be replanted to enhance habitat adjacent to the lake. The design elements of the new park design will enhance the recreational benefits of the project and promote ecosystem restoration and nonpoint source pollution abatement and education. Restoration and enhancement of the habitat in the riparian woodlands includes managing a number of nonnative plant species that are cumulatively contributing to a degraded community. These species include salt cedar, giant reed, ash, Himalayan blackberry, Brazilian pepper tree, passion flower, blue gum, and others. Nonnative species will be selectively removed throughout the park and replaced with native plant species typically observed in riparian habitats. Landscape plantings for the park will also be selected from an appropriate list of native species. An adaptive management approach will be used to cultivate a more robust riparian habitat that will benefit the overall function, health, and diversity of the plant and wildlife community of the Machado Lake ecosystem.

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Use of Decision Frameworks in Natural Resource Damage Assessments to Expedite and Promote Ecosystem Restoration

*Barbara J. Goldsmith*¹ and *Judi L. Durda*²

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This presentation will describe how decision frameworks (e.g., conceptual site models, multi-criteria decision analysis, weight of evidence frameworks and decision trees) can be used to further the objectives of the natural resource damage assessment (NRDA) process, namely to restore services provided to the public by a natural resource to its baseline through restoration, replacement or acquisition of the equivalent of the injured natural resource. Currently, there are two sets of federal regulations that provide an overall sequential framework for performing NRDA's; however, the regulations are optional and do not provide an opportunity to set priorities at a specific site, make key decisions at specific junctures of an assessment, address conflicts as they arise, and ultimately resolve claims sooner.

Natural resource damage (NRD) claims may be brought to restore injured, destroyed or lost natural resources (land, fish, wildlife, biota, air, water, groundwater, drinking water supplies and resources) and are in addition to site remediation or "clean up" requirements in those instances where natural recovery and remediation do not restore injured natural resources to baseline. Requirements for NRD claims are defined under both federal and state laws.

The presentation will present suggested sample decision frameworks that may be utilized during various stages of an NRDA's in order to set priorities, resolve conflict, address key issues and restore resource and ecosystem services. The presentation will also identify the needs, benefits and possible uses of decision frameworks in the NRDA and restoration context. The presentation will conclude with a case study example of how a decision making framework can be used in NRDA and restoration practices.

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Ducks Unlimited Annapolis Office: Conservation Strategies for the Chesapeake Bay

Kurt Dyroff, Kurt Anderson, Ben Lewis and Bernie Marczyk

Ducks Unlimited, Annapolis, MD, USA

Ducks Unlimited (DU) has established itself as the “Leader in Wetlands Conservation.” The DU Annapolis Office provides comprehensive wetland conservation services, including restoration and enhancement, land protection, and grant management, and delivers the whole package from planning and design to contracting, construction, and monitoring. A full complement of Annapolis Office staff includes biologists, engineers, and support teams that are well trained in the science of wetland conservation.

The Chesapeake Bay is a national treasure. Draining over 64,000 acres in six states, the Chesapeake is the largest estuary in North America and is unmatched in its history and tradition. It is also home to over 2,700 species of plants and animals, including over 20 species of waterfowl. The Chesapeake supports 70% of wintering American black ducks and 80% of Atlantic Population (AP) Canada geese; both are a regional priority. But the Chesapeake is important to more than just waterfowl. It also provides critical habitat to over 250 species of neotropical migrants, raptors, shorebirds, and wading birds. In fact, more than 3 million birds depend on its natural resources.

DU recognizes the ecological value of the Chesapeake and is committed to delivering a holistic approach toward its conservation. As it has always done, DU continues to provide on-the-ground habitat conservation. However, it is also advancing public policy initiatives, coordinating wetland mitigation, researching waterfowl ecology, and serving on regional management and technical committees, among other functions. DU utilizes both its traditional and non-traditional services to improve wildlife habitat, water quality, and quality of life in the Chesapeake and beyond.

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Vision for Protecting and Restoring the Chesapeake Bay Watershed Restoration and Measuring Success

James Edward

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The Chesapeake Bay — the largest estuary in the United States — is one of the nation's most unique, diverse and complex ecosystems. The Bay's watershed stretches across more than 64,000 square miles, encompassing parts of six states: Delaware, Maryland, New York, Pennsylvania, Virginia and West Virginia and the entire District of Columbia. The Chesapeake watershed includes more than 100,000 streams and rivers that eventually flow into the Bay. New efforts to restore and protect the Chesapeake watershed have received national attention recently. In this session, James Edward, acting director of the Chesapeake Bay Program, will explore some of the key initiatives and programs designed to restore and protect the watershed.

A new ecosystem-based strategy for the Chesapeake Bay watershed, developed under an executive order issued by President Obama, was released in May 2010. The *Strategy for Protecting and Restoring the Chesapeake Bay Watershed* ushered in a new era of shared federal leadership, action and accountability. It deepens the federal commitment to the Chesapeake region, with agencies dedicating unprecedented resources, targeting actions where they can have the most impact. Restoration goals and outcomes were developed jointly by the federal agencies to guide initiatives and actions. To increase accountability, the agencies will establish milestones every two years to ensure progress toward measurable environmental goals.

A Chesapeake Bay Total Maximum Daily Load (TMDL), published by the US Environmental Protection Agency (EPA) on December 29, 2010 was a historic point in the long history of Bay restoration efforts. This landmark "pollution diet" identifies the reductions of nitrogen, phosphorus and sediment necessary to restore clean water in the Chesapeake watershed. In addition to the significant environmental and economic benefits of a healthy Bay, the actions taken under the TMDL will also help clean local rivers, streams and creeks while supporting local economies and recreational activities. The final TMDL is based largely on the allocations and actions included in each of the jurisdiction's final Watershed Implementation Plans (WIPs)—or roadmaps for putting pollution controls in place by 2025. From its legal underpinnings to its strong accountability system, the TMDL is designed to deliver results.

EPA and the Chesapeake Bay Program are developing several new tools to help track progress on both of these restoration efforts. ChesapeakeStat is an interactive, web-based tool designed to increase government accountability and improve coordination of restoration actions by providing information on partner activities, indicators, strategies, funding, and progress towards goals. It will also be used to foster adaptive management by continually assessing progress towards goals and adapting strategies and tactics when needed. The Chesapeake Bay TMDL Tracking and Accountability System (BayTAS) is another tool that will help maintain focus on meeting established goals and milestones. BayTAS is a centralized system that combines data from EPA and the jurisdictions to track the allocations established in the TMDL, track progress on milestones identified in jurisdictions' WIPs, and record baseline nutrient and sediment control practices and progress toward meeting goals.

The Chesapeake Bay Program (CBP) is a unique partnership established by Congress in 1983 to lead and direct the restoration of the Chesapeake Bay. The CBP includes the states of Maryland, Pennsylvania and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the Environmental Protection Agency, representing the federal government; and participating citizen advisory groups.

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Development of a Technically-based, Objective and Strategic Monitoring Strategy to Guide Restoration in the South Florida Ecosystem

Angela Dunn¹, Gretchen Ehlinger¹, Patti Gorman², Susan Gray², Matt Harwell³, Eliza Hines⁴, Peter Rawlik², Brad Robbins², Tom St Clair⁴ and Dave Tipple¹

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Monitoring is currently being conducted to identify and evaluate environmental change that occurs across spatial and temporal scales to document restoration progress and implement an adaptive management (AM) program. Monitoring for ecosystem restoration programs can be classified into five categories: (1) mandated (*i.e.*, regulatory); (2) project operations (e.g. DO, nutrients, or flow); (3) project-level performance including the application of AM; (4) research; and (5) restoration assessment. In the Comprehensive Everglades Restoration Plan (CERP), the first four types of monitoring are typically conducted at the project-level. The fifth is the primary tool utilized by the Restoration, Coordination and Verification (RECOVER) Program to assess CERP performance.

Optimization of monitoring networks is an ongoing need especially for programs that are intended to detect multi-scale spatial changes that may occur across a suite of temporal scales. The need for a CERP-wide monitoring implementation strategy has emerged following reductions in fiscal year 2011 funding for several CERP projects; this had significant impacts on RECOVER Monitoring and Assessment Plan (MAP) and other CERP and non-CERP projects. Development of a monitoring implementation strategy has several expected outcomes including: (1) a rationale for the continuation or discontinuation of existing monitoring; (2) an explanation of how monitoring will help measure project performance; (3) a better understanding of how new knowledge will feed into predictive models (thus reducing the need to for additional monitoring); and (4) a better understanding of how system-wide and project-level monitoring can be efficiently integrated. The strategy, developed by an interagency team, focuses on a 3-5 year time period, linked to the Integrated Delivery Schedule (IDS). The monitoring implementation strategy is aimed at determining how to best implement monitoring to address remaining data/knowledge gaps and assess the performance of CERP projects before and after construction. Once the monitoring implementation strategy is developed, an annual prioritization process based on annual budgetary constraints will also be necessary; however, it will focus only on the upcoming year and how monitoring can be implemented to best utilize the empirical data being collected.

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Considerations for Ecosystem Restoration Adaptive Management Programs in Addressing Climate Change

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The U.S. Army Corps of Engineers (USACE), Jacksonville District is preparing a preliminary assessment of the vulnerability of the Comprehensive Everglades Restoration Plan (CERP) projects to accelerated sea level rise and climate change. This effort includes development of new tools and information needed to support more focused vulnerability assessments and development of adaptation strategies in the future.

When fully implemented, CERP alone will not be able to mitigate all impacts of climate change and sea level rise. However, CERP projects would reduce and delay impacts by increasing the ecosystems' adaptive capacities. The CERP projects provide a "frontline" of defense against a rising tide to allow ecological communities to migrate, reorganize, and reconfigure without significant declines in crucial functions in relation to primary productivity, hydrological cycles, social relations, and economic prosperity. Without the currently planned suite of CERP restoration measures, the impacts associated with sea level rise will be realized sooner, be of greater magnitude and more costly. Climate change may bring more intense rainfall events and more extreme droughts to the south Florida region. One of the most important adaptation strategies for mitigating these climatic stressors is to restore the capacity for freshwater flow through the Everglades to the coast and to increase storage available in the system. Fortunately, these are also main objectives of CERP. Additional climate change related benefits of CERP include increased freshwater flow to combat salinity increases caused by sea level rise and avoid impacts to human freshwater supply, enable mangrove and peat accretion in Everglades National Park, and allow for habitats and species to migrate at more sustainable temporal trajectories.

There is also a need to examine the science supporting the relationships between climate change stressors and ecological attributes. Conceptual and quantitative models need to factor in the uncertainty on effecting stressors and ecological response. Information in the literature suggests that restoration targets (performance measures) will need to be modified to account for migration of habitats and species. Scientific hypotheses likely need to be modified to factor in how restoration efforts and other adaptation strategies will address these effects. Additional adaptation strategies beyond restoration efforts are likely necessary to allow the system to adapt to climate change effects, while maintaining key structures and functions in different areas if possible. Finally, monitoring and assessment efforts need to consider parameters that are likely to respond to climate change in order to provide feedback to scientists and restoration managers on any additional adaptive management actions to take.

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Metrics, Models, and Methods: Predicting Post-Restoration Stream Health

Jason D. Evert

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Stream degradation in urban areas can have profound effects on local and downstream aquatic communities. Due to population growth, land development, and the subsequent reduction of watershed pervious surfaces, the need to restore and enhance streams is increasing. While competition for funding the *construction* of restoration features is likewise increasing, fiscal resources for even the *evaluation* of candidate restoration streams (and predicting the effectiveness of proposed restoration treatments) are extremely limited. When detailed scientific investigations cannot be engaged due to the demands of schedule or funding, rapid methods for assessing stream biota and habitat are usually employed. However, predicting how a restored system benefits its resident biota and habitats continues to be major challenges facing resource managers and decision-makers. The proposed restoration of Jackson Creek by the U.S. Army Corps of Engineers and Gwinnett County (Georgia) offered an opportunity to evaluate novel methods for assessing existing conditions and predicting benefits for the aquatic community given various restoration scenarios. The use of available hydraulic and other physical data was critical in that effort, as was the examination of relationships between physical and biological parameters within the focal system and the consideration of various environmental models from other regions.

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Ecosystem Planning at Warp Speed: The LCA Medium Diversion at White Ditch Story

*Jason W. Farmer*¹ and *Andrew D. MacInnes*²

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In less than 2 years, a regionally integrated Corps team with interagency team members went from authorizing language to a signed Chief's report for the largest ecosystem focused freshwater diversion ever proposed for Louisiana. This presentation details experiences and lessons learned along the way.

Title VII of the Water Resources Development Act (WRDA) 2007 authorizes the Louisiana Coastal Area (LCA) ecosystem restoration program. Included within that authority are requirements for comprehensive coastal restoration planning. The Medium Diversion at White Ditch (MDWD) was one of six "near-term critical" concurrently managed LCA projects (LCA 6) that kicked off on January 12 2009. The goal from day 1 was obtaining a signed favorable Chief's Report by December 31 2010 for all six projects. The "normal" timeline for a Corps project of this magnitude would be 4-5 years. The LCA teams would have less than 2.

The MDWD Project Delivery Team (PDT) was unique among the LCA 6 in that it was truly regionally integrated and also had team members from other state and federal agencies. Program management and project oversight was with the New Orleans District (MVN). Project Management was shared between MVN and the St. Louis District (MVS). The various technical leads and specialties were scattered across MVN, MVS, and Rock Island (MVR) with some technical assistance from St Paul (MVP) and Memphis (MVM). The USFWS was a full PDT member and provided project benefits analysis as well as written sections of the document.

The project kicked off on January 12 2009 and by July 8 2009, a Feasibility Scoping Meeting was held. By January 3 2010, a Tentatively Selected Plan was determined and a Draft version of the Report was complete. On April 15 2010, the team successfully completed the Alternative Formulations Briefing. By the end of May 2010, Public Review and Independent External Peer Review were underway. By August 26, 2010 the tentative plan was accepted and recommended by the Civil Works Review Board in Washington D.C. By November 2010 the Final document was complete and legal certification was obtained. On December 30 2010, the Chief of Engineers signed a favorable report.

The interagency team selected a 35,000 cfs Diversion as the Recommended Plan because it best met the study objectives, was the most flexible, and had the most robust sustainable capability against relative sea level rise. A unique pulse regime was developed and chosen because it capitalizes on sediment availability while minimizing adverse effects. The fully funded project cost is \$387,620,000. The project would result in restoration of natural deltaic processes within the study area. In partnership with the Louisiana Office of Coastal Protection and Restoration the Corps planned and intends to design and build a project that serves the needs of the nation.

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Integrated Modeling Framework and Decision Support for Forecasting Ecosystem Services

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The Lower Mississippi Valley (LMV) has experienced extensive loss and conversion of forests and wetlands in the past and there are now large-scale conservation efforts targeting the restoration and enhancement of ecosystem structure, functions, and services. These efforts need both patch- and landscape-level management, assessment, and monitoring. Landscape-scale decision-support tools are necessary to assess both direct and ancillary effects of conservation practices on ecosystem services and to simultaneously evaluate the impacts of future management actions while considering potential changes in land use and climate.

We have developed a frame-based ecosystem services modeling platform to explore the relationships between site and landscape variables and specific ecosystem services, such as wildlife habitat (bird species richness, duck energy days, amphibian occupancy rates), climate regulation (carbon sequestration), and water quality (potential nitrate retention, soil erosion potential). The framework allows the integration of several modeling components and displays the dynamic outputs for each of these models simultaneously. The platform provides data flow for individual models, the execution of external models, real-time running of internally implemented models, data transfer between co-dependent models, and a visualization component for the landscape maps, graphics, and text outputs.

The user designates a spatially explicit study area (e.g., a county, basin, or a landscape around a restored area of interest) that the model then represents as a raster land-use, land-cover (LULC) map (at various grid cell sizes). This initial base map then changes with each time-step according to LULC change scenarios, which can be user-defined, outputs from a land-use change model, or a set of economic or policy transition rules. The creation of new restored forest patches, or the transition back to agriculture, creates a dynamic landscape which affects the estimates of ecosystem services based on the size, age, condition, and configuration of LULC patches, and on the total number of specific cells.

Forest Vegetation Simulator (FVS) models forest growth and development on the restored forest and natural forest cells. Hierarchical Bayesian statistical models are the basis for quantifying bird species occupancy and richness, and frog species occupancy components. Habitat suitability models will be used to model the potential habitat for specific bird species depending on structural variables at the patch scale and landscape metrics. Impacts on ecosystem services sensitive to hydrologic changes are being modeled with PRMS and SWAT.

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Comparison of Artificial Reef Substrates in Qatar

Deborah K. Fawcett, David Snyder, Alan Hart and Anne McCarthy

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Biological assemblages associated with three artificial substrates (EcoReefs[®] modules, concrete pipeline, and rock armament) were compared to the natural substrate off the coast of Qatar in the Arabian Gulf as a pilot study to evaluate the efficacy of EcoReefs[®] modules as artificial reef structures for use in mitigation in Qatari waters. This study was conducted by CSA International, Inc. (CSA) on behalf of Dolphin Energy Limited (DEL) to meet Ras Laffan Industrial City (RLC) environmental mitigation requirements for areas of seabed disturbed during nearshore subsea pipeline installation.

Bi-annual monitoring surveys were conducted over a 2-year period to test the null hypothesis that there is no difference in coral recruitment, epibiotic communities, or fish populations among the four substrate types or between two study areas. Substrate sampling units were established in two selected study areas to spatially compare the performance of EcoReefs[®] modules. Coral recruitment was low and varied by substrate type and project area, but was greatest on natural substrates in both study areas. Coral recruitment is expected to increase on all of the artificial substrates as they age since the artificial substrates provide greater relief off of the bottom, increasing the likelihood of survival of coral recruits. The epibiotic community associated with the artificial substrates consisted of fouling organisms along with biotic turf and solitary cup corals (Family Caryophylliidae), which is typical of other recently established (<5 years) artificial reef habitats in the Arabian Gulf. Epibiotic communities on the artificial substrates were more similar to one another than they were to the assemblage observed on the natural substrate, which was dominated by macroalgae, amorphous sponges, and colonial corals. Higher fish species richness and abundance were observed on EcoReefs[®] modules and rock armament substrates, which coincided with greater structural complexity compared to concrete pipeline and natural substrates. The EcoReefs[®] modules and rock armament substrates were primarily colonized by adult and juvenile fishes, suggesting that these substrates attract and aggregate fish from the surrounding waters.

While EcoReefs[®] modules provided greater structural complexity and relief off of the seafloor compared to natural substrates, the differences of these features between EcoReefs[®] modules and natural substrates may decrease over time due to burial and incidental breakage of branchlets, decreasing the efficacy of EcoReefs[®] as a mitigation alternative over time. With this consideration, of the three artificial substrates considered, rock armaments provided the most stable artificial substrate for colonization overtime, with high structural complexity and relief off of the seafloor.

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Program Management Support Contracts in Ecosystem Restoration

Brian K. Files

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This presentation will discuss the potential services provided to organizations by program management support contracts. Program management is the process of managing multiple, interdependent projects. It has become more and more common in both the public and private sectors for program management responsibilities to be contracted to consultants. The contractor essentially becomes an extension of client staff providing a wide variety of support capabilities, including planning, scheduling, budgeting, interagency coordination, regulatory compliance, design, construction management, operations and maintenance, logistical support, and information systems.

As an example, Parsons is part of a joint venture of consultant companies providing multi-disciplinary professional services for the Comprehensive Everglades Restoration Plan (CERP) through a program management support contract with the Jacksonville District, United States Army Corps of Engineers (USACE). CERP provides a framework to restore, protect and preserve the water resources of central and southern Florida, including the Everglades. It is one of the largest ecosystem restoration programs ever undertaken and has been used as a model for other large-scale water resource and ecosystem restoration projects in the United States and other nations.

Joint venture staff perform many of the activities necessary to manage individual projects on a daily basis as well as coordinate the program as a whole. These program-level activities include information and data management, financial reporting, other performance metrics reporting, and facilitation. The program management support contract has allowed the USACE staff to focus on the critical technical and policy issues related to their projects.

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Assessing the Benefits of Adaptive Management

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Recent policy guidance within the US Army Corps of Engineers requires the development of monitoring and adaptive management plans during feasibility studies for ecosystem restoration projects. Plans have been formulated for several projects using draft implementation guidelines. These early efforts suggest that this new mandate yields several benefits and may be truly transformative to the Corps' ecosystem restoration program. Adaptive management adds several considerations to the traditional planning process, including identification of needed monitoring during and following project construction, early identification and assessment of performance measures and decision criteria, and determination of desirable or necessary adjustments to the project restoration actions to address gains in site knowledge or unpredictable changes in site conditions. Addressing these considerations inevitably improves restoration plans and increases the likelihood for success, yielding both direct and indirect benefits. The direct benefits of adaptive management can be quantified in terms of improved project performance. Indirect benefits associated with the knowledge and insight gained from the process are difficult to quantify, but are clearly significant. This presentation outlines the approach to adaptive management that has evolved from early applications, and focuses upon methods for the identification and quantification of associated benefits.

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Big Muddy Metrics: Adaptive Management on the Missouri River

Timothy M. Fleeger

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This presentation focuses on a unique and innovative Adaptive Management (AM) approach to habitat restoration which includes flexibility in both NEPA compliance and implementation, and focuses on the use of management-relevant science to influence decisions on an annual basis. The Biological Opinion (BiOp) on the Operation of the Missouri River Mainstem System calls for an AM approach to implement actions to restore habitat for federally-listed species. Pursuant to compliance with this BiOp, the US Army Corps of Engineers constructs nesting habitat for two bird species - least terns and piping plovers – under its Emergent Sandbar Habitat (ESH) program. As part of a Programmatic Environmental Impact Statement (PEIS) on the ESH program, the Corps recently completed an AM strategy for this multi-million dollar program which is implemented annually over a large geographic area (400 river miles in four states). This AM strategy addresses adaptation at both programmatic, regional and site-specific levels and features a suite of measurable objectives including population numbers, productivity, habitat availability, area of impact and a learning objective; uncertainties to be addressed through program implementation; potential management actions with cost estimates and anticipated benefits; monitoring and research needs including cost estimates and priorities; and success criteria for each objective.

The PEIS also features a unique integration of NEPA and AM. The AM strategy is selected as the preferred alternative within the document and a maximum potential area of impact is disclosed. This will allow increased flexibility to implement the AM strategy for numerous years under the existing NEPA coverage. The strategy also employs a stochastic predictive model to forecast biological responses of terns and plover to alternative management actions and environmental scenarios and a series of decision criteria are used to recommend adaptations to the program and specific sites based on both monitoring data and model outputs. This presentation will provide an overview of the AM strategy and discuss results and recommendations from the first year of program implementation.

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Organizational Restructuring and Defining Roles and Responsibilities have Facilitated Implementation of AM within the Missouri River Recovery Program (MRRP)

C. A. Fleming

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In the MRRP we have experienced brief steps forward with AM and many barriers to achieving what would be called success. Today I will present two barriers we have experienced and how we are dealing with them. First, the original organizational structure, specifically, alignment of personnel within the program was not well suited for implementation. We learned that geographic location of personnel and defined level of responsibility in the implementation of AM were critical to implementation. Second, we found resistance to adjust our routine way of doing business at every level of implementation: agency, program, project and individual. To overcome these barriers we have restructured the organization involved in the MRRP to be more effective within the agency culture by clearly identifying the governing structure, roles and responsibilities, and appointing AM leads in both Districts. Second, we have explicitly defined roles and responsibilities within AM and the MRRP to improve communication and understanding, which in turn will help facilitate personal, project and program change. Once these and other measures were taken, we were able to develop some of the key elements in the AM program including defining decision-makers and the decision-making process, develop a central document (the Annual Adaptive Management Strategy Report), and engage scientists, managers and others in the process in order the speed the delivery of information required to assess progress toward goals, and define critical uncertainties.

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NRCS National Sage Grouse Initiative: Focused Working Lands Conservation

*Wendell C. Gilgert¹, Tim Griffiths² and Dave Naugle³ – presented by **Danielle Flynn***

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The Greater Sage-Grouse (GSG) is an iconic western bird with life history requirements that are landscape in scale. Their populations have been steadily declining for more than 4 decades. They are a sagebrush obligate bird whose habitat is experiencing an onslaught of threats that include habitat fragmentation, energy development, habitat loss from development and agriculture, and West Nile Virus. They are a candidate for listing under the Endangered Species Act. There are numerous other sagebrush obligate wildlife life species that while not yet listed, share the same “Ark of Peril” with the Great Sage-Grouse.

In February 2010 the United States Department of Agriculture’s (USDA) Natural Resources Conservation Service (NRCS) responded the decline of the sage-grouse with a Sage-Grouse Initiative (SGI) that directed additional Farm Bill funding and technical resources to the 11 state range of the bird. NRCS has worked with the array of Federal, State, Tribal, Academic, and non-governmental (NGO) groups to develop maps that delineate where the greatest GSG populations are concentrated in an effort to more strategically focus our resources.

Since its inception, the NRCS SGI has delivered focused training to over 500 NRCS and Partner Conservations who are assisting working lands ranchers to plan, design, and apply over 20 million dollars of sage-grouse specific conservation practices on the land. We are primarily using the Environmental Quality Incentives and the Wildlife Habitat Incentives Programs. In 2011, the Wetland Reserve and Grasslands Reserve Program funds are also being focused on the effort. An additional 30 million dollars will be contracted in this Fiscal Year.

Our presentation will highlight the variety of private land conservation efforts that include the removal of thousands of acres of invasive juniper trees, the removal and marking of fencing in areas heavily used by sage-grouse, prescriptive grazing actions that are resulting in higher foliar cover for GSG nesting and brood rearing, and range planting of more forbs and legumes to provide more insect food sources for GSG chicks. We will also provide a brief overview of the integration of new technology, vegetative and biological monitoring techniques, and educational outreach that are being employed to support this monumental landscape conservation effort.

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Aquatic Ecosystem Restoration of Lake Contrary, a Missouri River Oxbow Lake Unique Challenges and Planning Analysis Tools

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The U.S. Army Corps of Engineers and the Buchanan County Commission are proposing to restore Lake Contrary under the WRDA Section 514 program. Lake Contrary is an oxbow lake of the Missouri River located southwest of the City of St. Joseph in Buchanan County, Missouri. The lake was separated from Missouri River flood events by levee unit L-455 (constructed in about 1966). Historically, lake depths were reported to have been 18 – 20 feet, but the lake is now less than three feet in depth on average. Prior to levee construction, the lake was subjected to extensive accretion of sediments from major flood events since its formation in the early 1800s, resulting in lake senescence and the natural shift to more wetland habitat, eutrophic conditions and associated declines in aquatic fish species. Furthermore, the lake's water supply is problematic, as there are no surface water connections now. It has no regular inflows from the Missouri River now except from pressure reliefs associated with levee unit L-455 that operate infrequently from Missouri River flows. The lake surface elevation and water depth are now largely regulated by the alluvial groundwater table level and annual precipitation.

The lake is experiencing degraded water quality and a subsequent decrease in fish species and abundance from winter fish kills. Performing aquatic ecosystem restoration in oxbow lakes presents some unique challenges and opportunities. In this presentation, we will present some unique planning and analysis techniques and select results for dredging, water quality and supplemental water supply, sedimentation analysis, wetland restoration and enhancement, bioengineered shoreline stabilization, and riparian buffer establishment.

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Improving NEPA Alternatives Documentation for Objective Decision Making in Ecosystem Restoration and Endangered Species Recovery on the Missouri River: The Benedictine Bottoms Case Study

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In recent years, the U.S. Army Corps of Engineers (Corps) has come under more scrutiny both internally and externally in its NEPA decision making process related to water resource projects, particularly those with ecosystem restoration and endangered species recovery components. Comments can vary widely, often claiming inadequate scientific information and analysis, public and agency input, or deficiencies in NEPA process. For example, the Kansas City District Corps received comments from its agency partners on the Missouri River Fish and Wildlife Mitigation Project sites suggesting that the Corps might be acting pre-decisional in the NEPA alternatives development process. There are often sound and defensible reasons why some alternatives are not furthered in the Corp's NEPA planning and decision making process, but these reasons may be undocumented. This is especially true for smaller and more routine federal NEPA actions the Corps conducts, particularly Environmental Assessments. The purpose of this presentation is to show ways to improve alternatives development and documentation in NEPA documents using the Benedictine Bottoms Fish and Wildlife Mitigation Site on the Missouri River as a case study. The presentation will include better ways to define and document 1) project goals and objectives, 2) constraints, resource significance, and agency coordination, 3) actions considered, 4) action screening and results, and 5) alternatives formulation and selection as they relate to pallid sturgeon recovery and ecosystem restoration.

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Accelerating Ecosystem Benefits in Picayune Strand Using Advanced Construction

Bradley A. Foster

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The Picayune Strand Restoration Project (PSRP) study produced one of the first Project Implementation Reports completed, approved, and authorized in the Comprehensive Everglades Restoration Plan (CERP). The PSRP will restore to more natural conditions a 55,000 acre area that was overdrained by four large canals and crossed by a 279-mile network of roads. The canals and roads produced significant changes to the hydrology, vegetation and wildlife in the area.

The planning, review, and approval process for Corps of Engineers projects is often lengthy. After that, Congress must act to authorize the project and provide funds for construction. During the PSRP study the South Florida Water Management District (SFWMD), the non-federal sponsor, recognized the potentially long time for federal construction funds and also that the ecosystem quality was continuing to decline. The SFWMD selected a subset of the features of the project alternatives that would provide immediate benefits. They performed detailed design, and then plugged the upper two miles of Prairie Canal in late 2003 through early 2004. Water levels returned almost immediately, desired vegetation sprouted, and wildlife and endangered species counts increased. In August of 2006 construction to plug the remaining five miles of Prairie Canal was begun and completed in late summer 2007. In addition the first phase of road removal was begun in October of 2006 and completed in October 2007 resulting in the removal of approximately 65 miles of roads in the same area of the project as Prairie Canal.

The Prairie Canal advanced construction began before completion of the planning report in September 2004, Congressional authorization in 2007, and the project partnership agreement in 2009. There was significant coordination between the Corps and SFWMD so that the SFWMD could ensure that its early construction was consistent with the ongoing planning study so that that the work would be eligible for credit. The planning report stated that the Prairie Canal work was advanced construction of part of the recommended plan. The report contained recommendations that the non-federal sponsor receive credit for the planning, engineering, design, and construction before completing the PPA, if the Secretary of the Army determines that the work was necessary, reasonable cost, and integral to the project.

Several risk factors might have prevented credit. The recommended plan could have changed after construction started, new reviewers in Washington may have objected, or Congress might not authorize the project. For this approach to be used elsewhere, the non-federal sponsor must have the technical and financial resources to perform the work without federal participation. The sponsor must be able to accept the risk that credit might not be granted and the confidence that communications and approval processes will result in credit for the work.

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Tamiami Trail: Comparison of Ecological Benefit Methods Used by Different Federal Agencies

Bradley A. Foster

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The Tamiami Trail Highway was constructed in the late 1920s, and has been and continues to be an east-west barrier to the natural southward flow of water through the Everglades and into Everglades National Park. The highway has been a primary subject of four ecosystem restoration studies since 2000. I compare the processes and methods to characterize environmental benefits used by the 2005 and 2008 studies led by the Corps of Engineers (Corps) and the 2010 study led by Everglades National Park (ENP). All used a mix of modeling and non-model information to predict future environmental conditions for several alternatives. As the different studies proposed alternatives with different bridge lengths and roadway elevations, the analysis and results from earlier studies were not directly transferrable to later studies. The Corps studies used the hydrological and ecological performance measures to describe several components of the quality of the ridge and slough ecosystem of northern ENP. They were combined into a single index, which was then multiplied with the area affected to produce habitat units. The ENP study used similar but not identical performance measures. It used the Choosing By Advantages methodology to include the performance measures scores into importance scores.

A key difference among the methodologies is how they address important non-hydrological, non-ecological, or semi-quantitative effects, such as real estate effects, job creation, scenic vistas, and cultural resources. The Choosing By Advantages process explicitly combines all these effects into the single overall importance score for an alternative. The Corps' habitat unit methods do not directly consider these other effects directly into the score. These effects must be considered separately during the alternative selection process. Even with different methods, each study produced solidly supported recommended plans for Tamiami Trail.

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Comprehensive Watershed Planning for Nutrient Reduction in Ellerbe Creek, Durham, NC

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The Ellerbe Creek Watershed covers 25.3 predominately urbanized square-miles. Ellerbe Creek drains to Falls Lake and the Neuse River, both of which have been identified as nutrient sensitive. Falls Lake is also an important source of drinking water for local municipalities. Ellerbe Creek is currently on the North Carolina Division of Water Quality 303(d) list for biological impairment and is expected to be listed for fecal coliform. Nitrogen, phosphorus, and excess sediment in the watershed are of particular concern.

In 2007, the City of Durham initiated a watershed study to develop a comprehensive Watershed Management Improvement Plan (WMIP) for Ellerbe Creek to help restore ecological health and function to Ellerbe Creek and its tributaries. The WMIP focused on characterizing existing water quality and stream health; identifying nutrient loading contributions from point and non-point sources; identifying cost-effective measures to reduce nutrient loads; and identifying opportunities for stream restoration, preservation of high-quality riparian areas, and improving the City's riparian area maintenance practices. The authors will focus on several elements of the WMIP:

- The comprehensive assessment of approximately 20 miles of stream channels
- Inspection of existing stormwater BMPs to see if retrofits are a practical and effective means for nutrient reduction and improving water quality performance
- Development of a GIS-based water quality model to estimate the effectiveness the following measures at reducing sediment and nutrient loadings and other water quality benefits:
 - Over 300 stream restoration and riparian buffer enhancement projects
 - Potential Retrofits to 55 existing stormwater BMPs
 - Over 50 new stormwater BMPs
 - Point source control measures, such as nutrient control upgrades to the North Durham WWTP
 - Integrating Better Site Design and Low Impact Development (LID) measures
 - Installation of proprietary BMPs into fully developed urban areas
 - Non-structural measures to improve stormwater quality
- Prioritization of water quality improvement projects using a comprehensive set of 16 evaluation criteria
- Application of the GIS-based water quality model to estimate the sediment and nutrient removal effectiveness and costs of ten watershed improvement scenarios that combined the point source and non-point source water quality control measures listed above

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Great Rivers that Work for People and Nature

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The mission of the Nature Conservancy's (TNC) Great River Partnership (GRP) is to bring together diverse partners and sound science to expand options for achieving sustainable management and development of the world's great river basins. We seek shared solutions to common land- and water-use issues, recognizing the inescapable linkages between our economy, human well-being, and ecosystem sustainability. TNC's deep history and leadership role in the Mississippi River Basin is an important regional asset and serves as a foundation to promote exchange of knowledge and expertise globally.

Six Operating Principles underlie the GRP mission. Support coordinated **Sustainable River Basin Management** across sectors within a given river basin to optimize economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring river ecosystems. Serve as an **Honest Broker of Science and Policy** by bringing together diverse partners and sound science to expand options for achieving sustainable river basin policy, management and development, always recognizing the interdependence of economy, human well-being, and ecosystem health. Focus on **Common Dilemmas and Tangible Outcomes** using proof-of-concept projects on specific great rivers to test likely solutions for sustainable river basin management. Deepen **Key Areas of Global Expertise** including sustainable agriculture, floodplain management, navigation infrastructure management and adaptive management and connect with other areas of expertise, including sustainable hydropower, environmental flows, fisheries management, etc. Work with others to develop a multi-directional **Global Network** to share knowledge and best practices through technical exchanges, conferences, symposia, and virtual technology. Shape and communicate a **Credible Expert Voice** to generate a broad understanding and support for sustainable management of great rivers throughout the world.

We also review key outcomes of projects that were the focus of the GRP in the last five years, including: a) a technical exchange between government agencies in China and United States to support adaptive management on the Yangtze River; and b) efforts to improve systemic reduction of nutrients in the Mississippi River Basin through a combination of proof-of-concept projects linked to public policy and funding.

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Using Incentives to Connect Forests, Water, and Communities in the Northeast United States

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This innovative project addresses the increasing loss of private forests and threat to clean water in the U.S. by establishing a new conservation framework that will facilitate the sale of ecosystem services by private forest owners to buyers such as municipalities, government agencies, land trusts, nonprofit organizations, and corporations. Market-based approaches are proven effective incentives for sustainable forest management and watershed services. For example, conserving the water filtration functions of a healthy forest may prove cheaper than constructing a new water filtration plant. Consequently, a proactive, market-based approach will be cheaper and more effective than waiting for the time when a water filtration plant is needed.

Forested watersheds provide two-thirds of drinking water in the United States as well as flood protection, recreational opportunities, carbon sequestration benefits, and fish and wildlife habitat. Many municipal water supplies originate in nearby watersheds and forests near metropolitan areas are often the most critically threatened. In the Northeast, family woodland owners own more than half of the forested land, making them key players in any conservation or restoration strategy that protects the water supply and other ecosystem services.

To address this emerging issue in private forest management and restoration, the World Resources Institute, Manomet Center for Conservation Sciences, and American Forest Foundation, along with key partners, are developing and implementing the Northern Forest Watershed Incentives project that will financially recognize the value of forested watersheds to municipal and other downstream users. The project will provide economic incentives and technical assistance for family woodland owners to restore, enhance, and protect aquatic resources in two critical watersheds in the Northern Forest region—the Crooked River in Maine which feeds Sebago Lake and in turn provides the primary water supply to the city of Portland, Maine and the upper Connecticut River watershed which spans from the Canadian border to the town of White River Junction, Vermont. This conservation and restoration initiative will serve as template for replication across the northern forest range and beyond.

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Restoration of Freshwater and Intertidal Wetlands within Louisiana's Chenier Plain

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HDR assisted Cheniere Energy, Inc. with the development of a new liquefied natural gas (LNG) receiving terminal at Sabine Pass on the Texas-Louisiana border. The terminal site is on the Louisiana side about three miles from the Gulf of Mexico.

Environmental mitigation was required for impacts to wetlands and aquatic habitat. The mitigation was completed by converting former dredged material placement areas onsite and on adjacent private property into high-quality freshwater and intertidal wetlands. Of the approximately 340 acres of wetlands created and/or enhanced by Cheniere, HDR designed 67 acres of intertidal marsh and 113 acres of freshwater wetlands.

The intertidal marsh utilized a "scrape-down" technique to bring the existing grade of the former dredged material placement area down to elevations conducive to the growth of target marsh plants. The material excavated from the site was reused in construction of the LNG terminal. This method of constructing intertidal marsh allowed for the construction of tidal channels and ponds as well as islands. The islands were areas left at original grade for further diversity throughout the marsh. One of the challenges with designing the intertidal marsh was the presence of an existing road, situated along the shoreline, separating the marsh site from the tidal influence of Sabine Pass. Culverts were installed along the road to allow tidal flushing from Sabine Pass. Post-construction monitoring was performed to ensure sufficient tidal fluctuations were occurring within the marsh.

Freshwater wetlands were created through the modification of an approximate 113 acre dredged material placement area. The area already supported freshwater ponding, native vegetation, and water fowl. Modifications, such as levee upgrades and water control structures, were made to enhance existing features and utilize the entire area as wetlands. HEC-HMS modeling was used to define outfall discharge and impoundment discharge limits, with the goal to maintain two feet of ponded water. Both of these projects resulted in the creation of a variety of sustainable ecosystems, including freshwater and intertidal wetlands.

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Targeting Sediment Sources for Restoration Activities

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Management strategies that focus on stream and watershed restoration with the goal of reducing erosion and sediment flux should be based on a sound understanding of the sediment sources contributing to the sediment flux and the overall sediment budget of the watershed being investigated. Significant sediment sources in a watershed can be determined by undertaking complementary sediment-source fingerprinting and sediment-budgeting investigations. The sediment fingerprinting approach quantifies the relative importance of the potential sediment sources and the delivery of sediment from these sources. The sediment budget approach provides information on the magnitude and location of the fluxes, and the links between sources, sinks, and sediment output. Combining the two approaches can provide resource managers with information on where to target measures to reduce erosion, sediment delivery, and the net transport of sediment. An important product of this approach is the determination of upland versus channel sources of sediment. This presentation will discuss how these approaches are being applied in subbasins of the Chesapeake Bay watershed.

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Everglades Stormwater Treatment Areas: Two Decades of Integrating Science and Engineering for Ecosystem Restoration

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In 1994, the Everglades Forever Act (EFA) was passed by the Florida Legislature which required the South Florida Water Management District (SFWMD) to implement the Everglades Construction Project (ECP) consisting of large constructed wetlands, or Stormwater Treatment Areas (STAs), and the Everglades Agricultural Area Best Management Practices (BMPs) program. To date, over 45,000 acres (70 square miles) of STA have been completed and are in operation, and by 2012, an additional 11,500 acres (18 square miles) of STA will be fully operational. The EFA also required SFWMD to implement a research program to optimize the design and operation of the STAs, including research to reduce outflow concentrations to levels needed to comply with water quality standards in the Everglades including the phosphorus criterion. Over the past two decades, substantial progress toward reducing phosphorus levels discharging to the Everglades has been made. From October 1993 through April 2010, BMPs and STAs have collectively removed more than 3,500 metric tons of total phosphorus that otherwise would have entered the Everglades. Compared to the pre-STA/BMP period, phosphorus loads and concentrations discharged to the Everglades have declined while flows to the Everglades have increased.

The design, operation and management of STAs have continuously evolved to incorporate the scientific and engineering knowledge gained through optimization research and operational experience. There are several design and operational elements that are requisite to achieving and sustaining appropriate water quality treatment performance in STAs. Treatment cell topography is critical, especially when outflow phosphorus concentration targets are extremely low. Highly uneven topography results in non-uniform flow, hydraulic short-circuiting and the inability to maintain desirable water depths. After consecutive extremely active hurricane seasons in 2004 and 2005, it became apparent that enhancements were necessary to help reduce the impacts of wind and wave action within STAs during large storm events. Emergent vegetation strips were planted in numerous cells to reduce potential damage to submerged aquatic vegetation communities. STA dryout is a major concern due to potential mercury methylation and spikes in phosphorus concentrations upon rehydration. Therefore, the development of strategies to effectively manage STAs during regional drought conditions have been developed and include proactive measures to maintain minimum water levels in priority treatment cells in an effort to reduce vegetation stress and maintain treatment performance. In addition, proactive management of both desirable and undesirable vegetation within STAs is critical to achieving and sustaining treatment performance. Periphyton-based STA (PSTA) systems, which are currently being studied by SFWMD and the U.S. Army Corps of Engineers, may provide additional treatment capability. Evaluation of the PSTA treatment technology research data is underway to determine the feasibility of future large-scale implementation.

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Overview of Natural Resource Damage Assessment and Restoration

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Natural Resource Damage Assessment and Restoration (NRDAR) is the process used to determine whether public natural resources have been injured, destroyed, or lost as a result of a release of hazardous substances or oil and to identify actions and funds needed to restore such resources. NRDAR is authorized by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Oil Pollution Act of 1990 (OPA) and the Clean Water Act (CWA). These statutes designate Federal, State and Tribal government officials to act as trustees on behalf of the public to recover damages from responsible parties to restore injured, destroyed, or lost natural resources. Damages can include money for trustee implementation of restoration actions and/or actual work undertaken by responsible parties with trustee oversight. Injured natural resources and the services they provide are restored at the expense of the responsible party, not the taxpaying public.

Restoration, as defined in the NRDAR statutes and regulations, encompasses activities to restore, replace, or acquire the equivalent of the injured natural resources. Due to the breadth of this definition and the variety of natural resources managed by Department of the Interior bureaus and co-trustees, restoration can take many forms. Successful restoration of injured resources relies on the dedicated effort of NRDAR practitioners within the Federal, State, and Tribal trustee agencies and many partner organizations. This presentation will serve as an introduction of the NRDAR process and an overview of this and the following session. The goals of these two sessions are to bring together restoration practitioners with a diverse range of experiences to discuss strategies for natural resource restoration activities, to increase awareness of the NRDAR framework among those who are not currently involved in NRDAR activities, and to explore potential avenues for partnerships between NRDAR restoration activities and other ecosystem restoration programs.

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Maryland's Large-scale Eelgrass (*Zostera marina*) Restoration: A Retrospective Analysis of Techniques, Costs and Monitoring

Rebecca Raves Golden, Kathryn E. Busch, Lee P. Karrh, Mark J. Lewandowski, Thomas A. Parham and Michael D. Naylor

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In response to systematic losses of submerged aquatic vegetation (SAV) in the Chesapeake Bay, the Maryland Department of Natural Resources, along with other Chesapeake Bay Program partners, initiated a large-scale eelgrass (*Zostera marina*) restoration project in 2003. The goals of the multi-year project were to develop and implement innovative techniques for large-scale eelgrass restoration using seeds. From 2003 to 2008, tens of millions of eelgrass seeds were dispersed over 27 hectares (67 acres) in the Maryland portion of the Chesapeake Bay.

Eelgrass seeds were dispersed through one of two methods: spring seed buoys and fall seed broadcast. Annual costs ranged between \$6,674 and \$165,699 per hectare and were dependent on the seed density and dispersal method used. Variability in seed collection yield and seed viability had the greatest impact on final costs. However, the use of seeds for large-scale eelgrass restoration offers a cost-effective alternative to more traditional transplanting methods.

Eelgrass seedling establishment was consistent for both of the seed dispersal methods. While eelgrass survival was influenced by seed dispersal method and annual variability, restoration site-specific habitat conditions had the greatest impact on the persistence of restored eelgrass. Restored eelgrass on the Potomac River continues to persist and expand, both vegetatively and sexually, beyond initial seed dispersal areas.

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Epoch-Era Analysis: A Design Tool for Ecosystem Restoration Projects in the Context of Changing Climate?

Kris Esterson¹ – presented by **Matthew Goldman**²

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Ecosystem restoration projects may take decades to plan, design, construct, and ultimately achieve restoration targets. Infrastructure built to support these programs is often designed to perform for 50-100 years or more. Over the long lifespan of restoration projects and related infrastructure, climate is expected to change significantly compared to conditions present during planning and design. For projects that are vulnerable to the effects of climate change, the ability to deliver sustained value to stakeholders may be jeopardized. This observation raises questions about how project performance and value robustness can be maintained in the context of climate change.

Traditional planning approaches used in ecosystem restoration often assume climatic stationarity. This is often followed by a design phase that employs a paradigm of optimization within that climatic context to identify the “best” or “preferred” design alternative. This optimization approach is valid only if the assumptions of the analysis remain fixed; an approach that is perilous in the context of changing climate. A project optimized for the climate of the past may be poorly suited for future climatic conditions and, if lacking adaptive capacity, suffer from performance degradation.

What approaches are available for such climate change related design challenges? An answer may be found in tools applied in systems engineering. Engineers at the Massachusetts Institute of Technology developed a tool, Epoch-Era Analysis, for planning the evolution of complex engineered systems as they are subjected to changing contexts. Epoch-Era Analysis is an approach for conceptualizing system timelines where the context and expectations for the system change over time. The approach designates an Era representing the lifespan of a system. The Era is subdivided into Epochs representing periods of time for which the system has fixed context and fixed value expectations. Using this analytical context, projects are designed for changeability to enable transition through contexts while maintaining value.

While the concepts of Epoch-Era Analysis are immediately applicable to climate change related design challenges faced by ecosystem restoration projects, tailoring the process for this new context would likely increase its utility for the restoration community.

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Lower Columbia River Pile Dike Assessment

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The Lower Columbia River (LCR) contains approximately 250 pile dikes between River Mile (RM) 3 to RM 138, near Bonneville Dam. Pile dikes have traditionally been constructed in the LCR to modify flow within the river cross-section to: A) reduce dredging requirements, B) provide channel stabilization, C) protect dredged material disposal sites, and D) provide bank protection. Construction of the LCR pile dikes was initiated in 1885 and continued in several phases through the 1960s. Almost all existing pile dikes are at least 50 years old (some are over 100 years old) and are in varying states of deterioration.

The LCR also contains critical habitat for 13 federally ESA-listed species of salmon and steelhead that have been significantly impacted by the installation and operation of the Federal Columbia River Power System (FCRPS) dams and navigation system. As part of the ESA-listed fish recovery effort, the National Oceanic and Atmospheric Administration (NOAA) prepared the Estuary Model to identify salmonid survival limiting factors and threats in the estuary. NOAA identified pilings and pile dikes as one of the many threats to juvenile salmonids because they create favorable conditions for predators of salmonids, reduce access to shallow water habitat, and modify natural habitat forming sediment transport processes. When NOAA issued a final Biological Opinion on the FCRPS in 2008, it included reasonable and prudent alternative (RPA) 38 intended to increase access to productive habitat and to reduce avian predation of juvenile salmonids through the implementation of a piling and pile dike removal program.

In an effort to determine the potential effect of each pile dike on juvenile salmonid habitat in the Estuary, the US Army Corps of Engineers, with technical assistance from AECOM, conducted an assessment of the approximately 250 pile dikes. The purpose of the pile dike assessment was to evaluate the functional and structural integrity of the pile dikes and pile dike systems, and their potential for impacting salmonid habitat. The pile dike assessment included the compilation and review of documents, data, and photos related to the construction and maintenance of the pile dikes and the dredging of the river's navigation channel, review of recent LiDAR and bathymetric data, and a physical inspection of each dike.

After completion of the assessment for one of the five river reaches in the study, it is apparent that there will be some pile dikes that will be recommended for removal to reduce their impacts to salmonids, but most of the pile dikes were neutral to habitat. Contrary to previous assumptions, some pile dikes were observed to be beneficial to habitat and should remain in place. The assessment is expected to be completed in 2011.

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Wapato Access Feasibility Study: Restoring Columbia River Salmonid Rearing Habitat

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The Bonneville Power Administration (BPA), US Army Corps of Engineers (Corps), and the Bureau of Reclamation (Bureau) collaboratively operate the 31 multi-purpose dams of the Federal Columbia River Power System (FCRPS) primarily to provide hydroelectric power, flood control, navigation, and irrigation services to the Pacific Northwest. The Columbia River drainage basin is nearly 260,000 square miles in area and is over 1200 miles long. It contains critical habitat for 13 federally ESA-listed species of salmon and steelhead that have been significantly impacted by the installation and operation of the FCRPS dams. In 2008 the National Oceanic and Atmospheric Administration (NOAA) issued a final Biological Opinion that included a list of strategies divided into reasonable and prudent (RPA) alternatives intended to avoid or reverse adverse modifications to critical habitat for ESA-listed species. One of those strategies is dedicated to improving fish survivability in the Columbia River Estuary and includes an RPA to identify potential habitat restoration and protection projects in the Estuary with the highest value to salmon and steelhead.

The Lower Columbia River Estuary Partnership is a non-profit bi-state organization whose mission is to rehabilitate, enhance, protect, conserve, create, and restore tidal wetlands and other key habitats in the lower 146 miles of the Columbia River (Estuary). They have consulted with AECOM to conduct a study to determine the feasibility of restoring floodplain connections through levee breaching for a site near Portland, Oregon to provide additional off channel juvenile salmonid and steelhead rearing habitat. The project site is the State owned Wapato State Access Area located along the Multnomah Channel on Sauvie Island in Multnomah County, Oregon. The site consists of approximately 156 acres of wetland and forested upland.

Multnomah Channel is a side channel of the Willamette River which is a major tributary to the Columbia River. Evaluation of the feasibility of the site for restoring rearing habitat was conducted by creating a synthetic long term river stage record using an onsite water level data logger located in Multnomah Channel to gather site specific water surface elevations for one spring freshet, then calibrating and extrapolating that data with the long term stage records from a downstream gage. Analysis was conducted on the synthetic stage record and site topographic mapping to determine the depth, aerial extent, and duration of floodplain inundation on a monthly basis for direct comparison with juvenile fish outmigration records.

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U.S. Army Corps of Engineers Role in the Great Lakes Restoration Initiative

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In the FY 2010 Budget, President Obama included \$475 million for the Great Lakes Restoration Initiative (GLRI), a multi-year, multi-agency initiative for the restoration of the Great Lakes ecosystem. The Environmental Protection Agency (EPA) is leading the Initiative and has developed a 5-year GLRI Action Plan, with input from federal agencies, tribes, states, and other stakeholders. The Initiative builds upon the work of the Great Lakes Interagency Task Force and the Action Plan is intended to operationalize the Great Lakes Regional Collaboration Strategy.

The Action Plan identifies five focus areas for GLRI funding, with near-term and long-term objectives for each focus area and metrics for measuring progress. The five focus areas are: 1) Toxic Substance and Areas of Concern; 2) Invasive Species; 3) Habitat and Wildlife Protection and Restoration; 4) Nearshore Health and Nonpoint Source Pollution; 5) Accountability, Education, Monitoring, Evaluation, Communication and Partnerships. The Action Plan is being used by federal agencies in the development of the federal budget for Great Lakes restoration in fiscal years 2011 and beyond. As such, it serves as guidance for collaborative restoration work with participants to advance restoration.

In coordination with the EPA and others, the U.S. Army Corps of Engineers developed a robust proposal for funding in FY10 that totaled approximately \$46 million. A variety of USACE authorities and programs were used to develop the proposal which includes priority projects to address problems and opportunities in all five focus areas. Approximately 60 percent of the USACE allocated FY10 GLRI funds will be used for “on-the-ground” construction and 23 percent will be used to plan and design restoration projects that should be ready for construction in a year or two. The remaining 17 percent is for studies, monitoring, and coordination that will guide long-term restoration and resource management decision making. This presentation provides additional details on the execution of the FY10 program and development of future fiscal year programs.

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Role of Ecosystem Services in Watershed Management

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The objective of this project is to assess the role of ecosystem services in directing watershed management actions to restore an impaired estuarine system. Los Peñasquitos Lagoon is a coastal estuary in San Diego County, California. The lagoon and surrounding watersheds provide numerous ecosystem services and societal benefits, including flood control, recreation, aesthetics, wildlife habitat, and endangered species protection. Over the past 40 years, development of the coastal zone in southern California has increased rapidly, leading to a variety of anthropogenic stressors on the coastal environment. During that timeframe, the lagoon has experienced a dramatic increase in the amount of sediment that it receives from three upstream drainages. The increased sediment load has impaired the lagoon, particularly in the upper portions of the estuary, where increased siltation has converted productive, diverse salt water habitat to less desirable fresh water marsh habitat. Due to the impairment and associated loss of services provided by the coastal estuary, regional regulators have issued a Total Maximum Daily Load (TMDL) for siltation in Los Peñasquitos Lagoon. The implementation Plan for the TMDL requires a diverse stakeholder group to reduce sediment loads to the lagoon by nearly 70% in the next ten years to achieve the desired waste load allocations. Restoration of the lagoon to pre-impact conditions is also required by the TMDL. Ecosystem services is being used as part of the stakeholder process for the TMDL Implementation Plan to facilitate selection of cost effective sediment reduction options that also achieve other ecosystem restoration goals. Measures and indicators of ecosystem services are being incorporated into applications of tools such as cost effectiveness analysis and incremental cost analysis to help identify tradeoffs and compare those projects that are most effective at reducing sediment loads to the lagoon with projects that achieve multiple goals associated with restoring ecosystem services. In addition, the prioritization process will characterize the numerous ecosystem services provided by the lagoon and its watersheds to assist stakeholders in selecting restoration projects that meet the regulatory requirements of the TMDL, enhance existing ecosystem services provided by the lagoon, and restore services that were present prior to anthropogenic impact.

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Louisiana Coastal Restoration and LCA Overview, State of Louisiana's Perspective

Bren Haase and *Jammie Favorite*

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The severe degradation of Louisiana's coastal ecosystem and its impact to both the State of Louisiana and the Nation has been well described. For more than 20 years the State and Federal government, local communities and non-governmental organizations have developed and implemented projects in and effort to partially restore that ecosystem. Restoration experts and well as state, federal and community leaders have recognized that a more comprehensive large-scale approach to restoration planning and implementation is needed to achieve a sustainable Louisiana coastal ecosystem. Additionally, the recent catastrophic hurricanes of 2005 and 2008 (Katrina, Rita, Gustav and Ike) and the Deepwater Horizon Oil Spill have highlighted the need for a healthy resilient ecosystem for the good of the state and nation. The State of Louisiana has begun to change its approach to coastal ecosystem restoration and protection planning and implementation to include a comprehensive systems approach that includes realistic targets and expected outcomes under varying future scenarios (i.e., funding, sea level change, sediment availability, etc.).

The Louisiana Coastal Area (LCA) program, authorized by Congress in the Water Resources Development Act of 2007, includes 15 near-term coastal Louisiana restoration projects and a science and technology program intended to resolve coastal restoration uncertainties. It was developed as a first step in this changed ecosystem restoration approach. The State of Louisiana will present its views on the need for coastal ecosystem restoration, the collaboration between the Corps and the State to complete feasibility studies for the first cohort of those 15 projects, the "LCA 6" projects, and discuss some of challenges from the local sponsor perspective in accomplishing that over a 24-month period. In addition, the state will present its perspective on how the LCA program fits into its overall ecosystem restoration and protection program and provide a status on the of the "Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan for a Sustainable Coast" 2012 update.

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Understory Recovery Following Cogongrass Eradication in a Longleaf Pine Sandhill Community

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With invasions reported on six continents, cogongrass is increasingly recognized as one of the world's most problematic invasive plants. In total, some 500 million hectares worldwide have some degree of cogongrass infestation. In the Southeastern US, over 600,000 hectares are infested – an area considerably greater than that covered by kudzu (*Pueraria lobata* Willd.), another well-known invasive species common to the region. Like many of our most noxious invasive plants, cogongrass readily invades disturbed sites, but is also capable of invading relatively undisturbed natural areas. Longleaf pine (*Pinus palustris* Mill.) sandhill ecosystems of the Southeastern Coastal Plain, for example, are frequently invaded by cogongrass. The transformative effects of cogongrass invasion on natural ecosystems (including longleaf pine) have been well documented and include drastic changes in plant community structure and composition, altered soil chemical and microbiological properties and modified fire regimes. Unfortunately, while progress has been made at eliminating cogongrass in natural areas, little is known about how these alterations to ecosystem structure and function persist following eradication.

The objective of this study was to elucidate the patterns of understory recovery following cogongrass eradication. I employed a chronosequence approach, using randomly placed 2 m circular plots to quantify species and functional group cover in sites where stands of cogongrass were eradicated at different times over the last 7 years. Results show significant differences in groundcover functional group composition between treatments. Forb cover, as a percent of total cover, was highest three years after eradication (45.7%), followed by 5 years (41.0%), 7 years (32.7%) and reference (20.9%). Relative grass cover, however, was highest after 5 years (37.2%), followed by 3 years (32.4%), 7 years (29.8%) and reference (25.0%). Tree seedling and sapling cover, on the other hand, showed a different trend, increasing from 5.4% at 3 years to 8.0% and 14.0% and 5 and 7 years, respectively, with the latter not being significantly different from reference (21.3%). Shrub cover increased – albeit not significantly – after eradication (4.4%, 6.0% and 11.3% for 3 5 and 7 years respectively), but remained significantly lower than reference (23.6%). Simpson's and Shannon-Weiner indices showed a pattern of increasing understory diversity and decreasing dominance after eradication, approaching reference levels after 7 years. Plotwise species richness increased with time, again being lowest at 3 and 5 years (5.6 and 6.7) and increasing after 7 years (12.8). The reference community averaged 14.4 species/plot. Ordination techniques indicate that, even after seven years, the composition of formerly invaded sites remains markedly different than the untreated reference community.

These findings indicate that native understory recovery following cogongrass eradication is a slow process – perhaps much slower than land managers would prefer. Additional research is underway to shed light on the barriers to native species establishment in these sites.

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10 Billion Dollars of Ecosystem Restoration at a Glance: Lessons learned from the Everglades Integrated Delivery Schedule

Karen S. Tippett and Brooke Hall

Jacksonville District, U.S. Army Corps of Engineers, Jacksonville, FL, USA

The South Florida Ecosystem Restoration (SFER) Program is a State-Federal civil works program of unparalleled magnitude spanning the planning, design, funding and construction continuum of the program management lifecycle. If constructed as originally planned, the SFER Program represents over \$10 billion worth of federal and state funding over 30 years to restore the quantity, quality, timing and distribution of water from the headwaters of the Kissimmee River through Everglades National Park and on into Florida Bay. Typical ecological restoration projects will include massive above-ground reservoirs coupled with stormwater treatment areas, the removal of miles of levees and canals, and the restoration of clean sheetflow and a more natural hydroperiod to tens of thousands of acres of remnant Everglades wetlands.

The SFER Integrated Delivery Schedule (IDS) is a program management tool that was developed in response to recommendations of the National Academy of Sciences and the US Government Accounting Office in 2006 and 2007. While the original intent of the IDS was to quickly and clearly lay out for senior managers the schedule and funding requirements for all of the ongoing SFER state and federal projects, it has gradually evolved into a more sophisticated tool. The current version of the IDS allows users to manipulate the construction sequencing of future restoration projects using existing detailed project schedules, budgets, programmatic constraints and estimates of ecological benefits to evaluate the relative benefits and costs of various scenarios. The authors will share their thoughts and first-hand observations regarding the challenges and obstacles associated with developing a “simple” program management tool that can quickly show more than \$10 billion worth of civil works construction over three decades in an easy-to-comprehend format while not compromising the fidelity of the underlying project management schedules and budgets.

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Benthic Ecological Assessment for the Great Lakes Method

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The Benthic Ecological Assessment for the Great Lakes (BEAGL) is an *in situ* field methodology for collecting quantitative data on the physical and biological habitat characteristics of the freshwater benthic environment. The BEAGL methodology is a freshwater adaptation of the Benthic Ecological Assessment for Marginal Reefs (BEAMR) commonly used in the marine environment as the main monitoring tool used to track changes in the marine benthic environment (Makowski et al 2009). The data collected through the BEAGL methodology has a multitude of applications including; habitat characterization, benthic habitat monitoring, groundtruthing sidescan or multibeam bathymetric surveys, benthic resource mapping, etc. Furthermore, BEAGL data can serve to compliment data collected by traditional benthic sampling methods (e.g. Ponar or Eckman dredge, Shipek grab, hooka apparatus, etc.), thus providing a more comprehensive assessment of the benthic environment.

In addition to standard parametric statistical tests, the BEAGL data can be directly imported into nonparametric, trend analysis statistic packages (e.g., PRIMER-E_ v.6; see Clarke and Gorley, 2006). This allows for a comprehensive nonmetric, multidimensional scaling (MDS) of the BEAGL data, which enables a researcher to view an entire benthic community, and all of the benthic functional groups, as one collective statistical factor. By doing so, change detection within the benthic habitat over time is evident. If changes are detected, an analysis of similarity (ANOSIM), the approximate analogue to the parametric ANOVA, is calculated to see if there were any significant differences occurring within the BEAGL data among the different sampling events or sites.

In a pilot study we tested the resolution of the methodology on various substrate types in the nearshore benthic environment of Lake Erie. Results of this study suggest that BEAGL data can provide researchers and resource managers with accurate *in situ* documentation of various aspects of benthic freshwater communities, allowing for more effective management of these unique freshwater habitats.

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Desired Characteristics of Aquatic Habitat Restoration and Preservation Prioritization Decision Support Tools

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The first three presentations of this session provided examples of how analytical frameworks have been developed to support prioritization decisions for complex habitat restoration and preservation in the Pacific Northwest, the Great Lakes, and the Gulf of Mexico. The complexity of environmental and human use interactions that lead to degraded environmental conditions in each of these systems have been long-term and incremental. Although all three could be considered advanced, state-of-the-art systems, vast differences exist in what lead to the evolution and development of these systems, their underlying analytical framework, the types of inputs and constraints, the extent of addressing interactions between competing human aspirations and the environment, and the implications of the output of these three decision support tools. Buck Sutter, a potential “buyer” of decision support systems in his role as Deputy Regional Administrator of National Marine Fisheries Services Southeast Region, joins three previous speakers, all developers of decision support systems, to discuss desired attributes and uses of future systems.

This panel will discuss key issues that impact how future habitat restoration and preservation decision support tools are used and applied, such as:

- What types of decisions are most applicable to be supported by a decision support system?
 - Where, how, and why are decision support systems useful?
 - What are we trying to fix with such tools, and who would buy or use them?
 - What are the attributes of an operational decision support system?
- Is keeping them “science-based” compatible with including human/environmental goals and interactions?
- How good is useful or good-enough? What are the trade-offs between decision support system complexity and utility?
- What does good look like in the upcoming decade, and what needs to be done to facilitate achieving this desired state?

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Communicating System-wide Science to a Spectrum of Audiences: Utilizing an Interactive Web-page to Publish the CERP System Status Report

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Communicating scientific information to multiple audiences with various interests and degrees of technical expertise is a challenge faced by many large-scale restoration efforts. For the Comprehensive Everglades Restoration Plan (CERP), the challenge has been how to best present formal assessments of data generated from the Restoration Coordination and Verification (RECOVER) Monitoring and Assessment Plan (MAP) provided in the System Status Report (SSR). The SSR plays an important role within CERP and represents the accumulation of multiple years of data on the status and trends of physical, chemical, and biological parameters assessed to establish pre-CERP reference conditions and ultimately determine whether the goals and objectives of CERP are being met.

To facilitate strategic communication, RECOVER has initiated the evolution of a traditional ~600 page paper document into an interactive web page (“webument”) accessible at http://www.evergladesplan.org/pm/ssr_2009/ssr_main.aspx. This web-based approach allows managers, stakeholders, and scientists to easily explore the SSR according to their interests and desired level of detail. Information is presented in a hierarchical manner, allowing users to initially access very general information about each assessment and to “drill-down” to increasingly detailed information. Assessments address: (1) the validity of hypothesis clusters and established functional relationships, (2) the status/trends of ecosystem components, and (3) linkages to Interim Goals and adaptive management for CERP.

Housed on the homepage is an interactive map encompassing the four MAP geographic regions and a navigation toolbar with links to major topics addressed within the document including Data Management, Adaptive Management, Ecosystem Components, Interim Goals and Interim Targets, and the Key Findings. The Key Findings is a high-level synthesis highlighting the findings with the greatest implications for restoration. Users can search for ecosystem assessment information geographically (via a map interface) or by ecosystem component (via navigation toolbars). Given this self-customization approach, scientists can enhance their focus on presenting their information for different audiences without having to generate multiple reports. Overall, this interactive web page provides an opportunity for more frequent updates and ongoing presentation of real-time assessments and trends in Everglades restoration.

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Establishing Successful Science/Policy Linkages: Challenges and Solutions for Science-based Restoration Decision Making

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A Coffee House panel comprised of senior scientists and current and/or former policy-level decision makers from restoration programs across the country will discuss how ideal communication and decision-making linkages remain to be achieved on a consistent basis. The Coffee House forum will be used to engage scientists and managers in the audience on identifying best practices and establishing and enhancing successful science/policy communication and decision-making linkages. An extended interactive discussion will focus on identifying the characteristics of ideal science-policy linkage for restoration programs with the aim of proposing alternative “models” of effective science/policy linkages. Next steps will focus on take-home messages from this session that will result in activities outside the scope of the NCER conference.

Key messages relevant for ecosystem restoration managers and scientists include focusing on successful science/policy linkages to examine:

- what mechanisms, approaches, and governance structures are working to foster science support for restoration decision making;
- what aspects are essential to effective science-policy linkages;
- the merits and drawbacks of different approaches to science/policy linkages in current programs; and
- scientists’ and managers’ views on the appropriate roles for scientists and the messages of science in restoration programs, in the context of overall decision-making processes by policy-makers.

The findings and conclusions presented here are those of the authors and do not necessarily represent the views of the Organizers’ agencies.

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Ecosystem Services and the Corps of Engineers: Now that We've Identified Them, We're Figuring Out What to Do

Jim E. Henderson

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During 2011, the Corps is seeking to identify mechanisms to utilize ecosystem services in formulation, evaluation, and operations of Corps ecosystem restoration projects. In embracing the ecosystem restoration mission, Corps policy recognized that restoration benefits are non-monetary in nature, focusing project formulation and evaluation on restoration of significant ecological structure, function, and dynamics. Focus on those attributes did not incorporate the broader range of ecological, economic, and social benefits resulting from the Corps' restoration efforts. Ecosystem services as components (structure, function, and dynamics) of nature are understandable within Corps guidance, but ecosystem services as the economic, cultural, and social outcomes or benefits are harder to fit in current Corps restoration guidance. The requirement of new Federal planning policy to "account for ecosystem services" is forcing the question of how the Corps will use ecosystem services in ecosystem restoration.

The Corps has participated in a number of ecosystem services efforts; the current work will bring these efforts together in identifying potential ways to use ecosystem services in project planning and benefits assessment. In a 2008 effort to improve assessment and evaluation of Corps restoration projects, fourteen ecosystem services influenced by the Corps were identified. Recent applications of ecosystem services concepts to project planning (e.g., a southwest riparian/riverine restoration project) indicated that ecosystem services are affected by Corps restoration efforts, but that restoration of or providing for ecosystem services is not considered when developing or formulating project alternatives. Also, since services aren't used in alternative formulation, data and information upon which to evaluate relevant services are lacking, i.e. not collected in early phases of project planning.

Efforts to identify how the Corps can apply ecosystem services in program and project planning and benefits assessment are heartened by the Corps' extensive engineering and planning experience, and its experience in implementing environmental analyses in complex planning and operations processes. That complexity may cause the greatest challenge – accounting for ecosystem service benefits in projects that were planned and perhaps constructed without addressing ecosystem services from the start.

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Invasive Species and the Corps of Engineers: What are the Costs?

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A sustainable, healthy ecosystem is required for successful execution of the Corps of Engineers (Corps) missions of navigation, flood risk management, and ecosystem restoration. In the last fifteen years, the agency has faced – and addressed -- significant impacts to its navigation, hydropower and water supply functions by invasions of zebra mussels (*Dreissena polymorpha*) and more recently impacts to recreation (camping) and natural resource management by spread of the Emerald Ash Borer (*Agrilus planipennis*) in the Midwest. Corps personnel report preventing, controlling or managing 120 invasive or nuisance (collectively called invasives) species (spp). Additionally species anticipated to be future problems, i.e. not currently problems are : Birds-3 spp; Fish-10 spp; Invertebrates-9 spp; Reptiles-6 spp; Plants-44 spp. Infestations that threaten the primary missions and functions receive visibility, funding, and high levels of action to ensure the agency missions are not diminished. Costs for measures to prevent and control high profile species become part of the ongoing planning and operations budgets, and are often not viewed as costs to the agency, i.e., just the costs of doing business. A careful examination of costs to all Corps activities reveals that invasives and nuisance species cost the Corps approximately \$113 million (M) annually. These costs include direct costs – labor, chemicals, removal and control activities – as well as indirect costs, e.g., increases or changes in types of maintenance, restoration of invasives-degraded ecosystems, and research.

The \$113 M annual costs are part of the Corps' approximately \$4.8 billion budget, roughly 2.5 percent. Invasives costs are incurred through the eight business lines under which the Corps' budget is organized. Estimating costs for invasives required considering how invasives affect the budgets of each of the business lines. Costs were estimated using Corps budget documentation, invasives control costs information, and estimates of impacts provided by Corps personnel responsible for invasive species.

The focus of the budget process on the business lines (e.g., Hydropower, Navigation, Water Supply, Regulatory) means that budget proposals are prepared to meet broad business line objectives which are holistic and system-centric, such as: "Ensure that projects perform to meet authorized purposes and evolving conditions." Management of invasives may get ignored or lost in the complexity of all the other components needed to meet the objectives. Additionally, the budget cycle – usually two years ahead – does not provide capability to meet emergency or unanticipated species invasions.

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Using Environmental Expenditures to Inform Restoration Planning

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The realities of restoration planning are that the system orientation and ecological principles (succession, competition) which are used to approach restoration have to be tempered by existing legal requirements, such as species protected under the Endangered Species Act or by basic ecological processes, e.g., invasives infestations, sometimes resulting from budget delays and just natural succession.

The Corps of Engineers (Corps) established two expenditures reporting systems, responding to other agency needs, that are providing information for restoration planning.

The Costs Template for Threatened and Endangered Species was established in 2006 to track species expenditures for operations, planning, and regulatory activities. The Corps spends in excess of \$300 million (M) annually to meet species commitments under the Endangered Species Act, roughly four percent of the Corps Civil Works budget. In developing plans for restoration, these TES expenditure data are useful for:

- Identifying regions with commitments in infrastructure, operations, and constraints. Major examples are the anadromous fish in the northwest and Piping Plover (*Charadrius melodus* \$10 M annually) and Pallid Sturgeon (*Scaphirhynchus albus* \$49 M) on inland navigation systems.
- The Corps protects close to 100 listed species of plants and woody vegetation which must be considered in terrestrial restoration plans.

In 2008 the Costs Template for Invasive Species was implemented to identify costs of invasives to Corps activities. Invasive species cost the Corps \$113 M annually.

- 120 invasive and problem species (spp) were identified by the Corps as currently being prevented, managed, or controlled.
- Of interest to future restoration may be the species identified as being future problems, i.e. not currently problems: Birds-3 spp; Fish-10 spp; Invertebrates-9 spp; Reptiles-6 spp; Plants-44 spp.

Information from the expenditure efforts can be used to project future conditions, identifying constraints and clarifying what can be reasonably expected from restoration efforts.

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Island Construction – Rebuilding Natural Levees to Restore Hydrologic Connectivity in the Northern Reaches of the Upper Mississippi River

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Over ten miles of islands have been constructed during the last 25-years on the Upper Mississippi River near La Crosse, Wisconsin to restore hydrologic connectivity and fish and wildlife habitat. Funding for this effort came through the Upper Mississippi River Environmental Management Program (EMP), a Federal program authorized in 1986, and reauthorized in 1999. An interagency, multi-discipline team including personnel from state natural resource agencies, the USFWS, and USACE worked together to plan and design these projects, which are located in the Upper Mississippi River Wildlife and Fish Refuge. Public meetings, boat tours, and information kiosks were used to keep the public connected with this planning and design process – the result being outstanding public support.

Natural levees are the high areas along either side of flowing channels where sediment deposits during floods. They are some of the most important geomorphic features in river valleys separating flowing channels from floodplain areas during most of the year, and being overtopped only during seasonal high water events. This seasonal overtopping, which temporarily increases hydrologic connectivity, results in the exchange of sediments, nutrients and organic matter between the river and its floodplain and provides seasonal habitat needs. On the Upper Mississippi River, however, lock and dam construction in the 1930s submerged the floodplain and most of the natural levees, leaving only the highest portions as islands. Submergence and subsequent island erosion increased connectivity between channels and the submerged floodplain (now called backwaters) to high levels that persist year-round rather than seasonally. This created a number of problems including reduced light penetration and aquatic vegetation growth, loss of over-wintering fish habitat, increased sediment deposition, and altered conditions in adjacent channels.

The island projects have rebuilt some of the natural levees, partially restored seasonal hydrologic connectivity and improved habitat for various species of fish, birds, and animals. Island design was based on opportunities, constraints, objectives, and performance criteria linking physical and biologic objectives. Design concepts, examples, and lessons learned during this 25-year restoration effort under the EMP will be included in this presentation.

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The South Florida Information Access (SOFIA) System and Everglades Depth Estimation Network (EDEN): Providing Support for Everglades Restoration

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The South Florida Information Access (SOFIA) system was created by the U.S. Geological Survey (USGS) in 1995. Its mission is to provide easy access to information about research projects and products generated as part of USGS Greater Everglades Priority Ecosystems Science (PES) and other Federal, State, and local science providers. SOFIA provides this service by integrating information systems and tools enabling efficient storage, organization, and search and retrieval of scientific information about the south Florida ecosystem. SOFIA was designed to benefit three major user groups: USGS program managers and scientists working with the Greater Everglades PES Program, managers and scientists working for other organizations involved with Everglades restoration, and members of the public interested in USGS research and the science behind the Everglades restoration effort.

SOFIA is an evolving and dynamic system that builds on the ever-increasing sophistication of new information technology. The current architecture consists of four integrated components: website, data, FGDC-compliant metadata, and database. The SOFIA website (<http://sofia.usgs.gov/>) provides links to all of these components including project descriptions, proposals, publications, data (via our Data Exchange website), metadata, presentations, and contact information, as well as items of general interest, such as photographs and posters.

The SOFIA site also hosts the website for the Everglades Depth Estimation Network (EDEN) (<http://sofia.usgs.gov/eden>). EDEN is a network of real-time water-level gages integrated with ground-elevation and water-surface modeling results that provides scientists and managers with current (2000-present), on-line water-depth information for the entire freshwater portion of the greater Everglades. Presented on a 400-square-meter grid spacing, EDEN offers a consistent and documented dataset that can be used by scientists and managers to guide large-scale field operations, integrate hydrologic and ecological responses, and support biological and ecological assessments that measure ecosystem responses to the implementation of the Comprehensive Everglades Restoration Plan (CERP).

The EDEN water-surface model uses the daily median values of up to 250 of the EDEN network water-level gages in the freshwater Everglades to create spatially continuous interpolations of the water-surface elevation. When combined with the ground elevation model, daily water depth and hydroperiod (days since last dry) are computed across the greater Everglades. The EDEN datasets and tools are readily available to users through the EDENweb which provides 'one-stop shopping' for hydrologic data with a consistent data format and full documentation.

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HEC Software Tools (EFM, GeoEFM, and EFMSim) for Ecosystem Restoration and Management

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The Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers (USACE) has been actively developing new software tools in the ecosystem restoration and management arena. This presentation provides an overview of EFM (Ecosystem Functions Model), GeoEFM, and EFMSim.

EFM is a software tool designed to help planners, biologists, and engineers determine ecosystem responses to changes in the flow regime. EFM analyses involve: 1) statistical analyses of relationships between hydrology, hydraulics, and ecology, 2) hydraulic modeling, and 3) GIS programs to display results and other relevant spatial data.

GeoEFM is the spatial component of EFM. It is programmed as an ArcMap extension and is being developed through a partnership between HEC and the Environmental Systems Research Institute (ESRI). GeoEFM computes and compares habitat areas for different water management policies, provides GIS calculators for querying spatial data sets, and offers a patch tool for looking at habitat connectivity.

EFMSim is being developed to simulate ecosystems spatially (for tens of millions of user defined pieces) and temporally (for tens to hundreds of years). Spatial data sets are used to describe the environmental conditions in which ecological communities exist. Communities respond (recruit, consume, grow, die, move, transition) according to rules defined by the user as a function of those environmental conditions. EFMSim is being applied to simulate restoration scenarios for a riparian and aquatic habitat restoration project on the Truckee River, Nevada.

EFM and GeoEFM are now available (free of cost) via the web at <http://www.hec.usace.army.mil/>. Since going online in 2008, EFM has had around 40,000 visitors and 4,000 downloads.

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Assessment and Restoration of Tribal Cultural Resources

Jennifer Hill-Kelley

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Paper mills along the Fox River released Poly-chlorinated Biphenyls (PCBs) into the river during 1957-1971. Because the PCBs reached the Reservation through the food web, the fish, eagles, mink and waterfowl have been injured. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) authorizes the Natural Resource Damage Assessment and Restoration (NRDAR) process for the restoration of areas injured by hazardous substances. CERCLA Section 101 and 107 authorizes the participation of Tribes as natural resource trustees and the Oneida Tribe of Indians of Wisconsin has been actively involved in the Fox River Natural Resource Damage Assessment since 1995.

Tribal natural resources are directly tied to Oneida cultural practices and a traditional diet. Specifically, fishing has long played an important role in the Oneida culture. The Oneida Tribe is a Trustee in the NRDAR to restore our traditional and cultural use of these natural resources. Our goal is to use settlement funding to create a sustainable fishery on the Oneida Reservation.

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Communicating System-wide Scientific Findings: Lessons Learned from Development of the RECOVER System Status Report

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The Comprehensive Everglades Restoration Plan (CERP or Plan) System Status Report (SSR) is an in-depth biennial assessment report which documents progress towards meeting the goals and objectives of the Plan. The SSR is produced by the interagency Restoration Coordination and Verification (RECOVER) group that assesses the system-wide ecological/biological monitoring produced by the CERP Monitoring and Assessment Plan (MAP). The scientific information in the SSR, including an assessment of the status of the ecosystem, is a critical component of the CERP adaptive management (AM) process.

System-wide monitoring and assessment for CERP is organized by geographic region in South Florida: Lake Okeechobee, Northern Estuaries, Greater Everglades and Southern Coastal Systems. The multi-faceted role of the SSR provides: (1) a synthesis of findings across geographic regions and across years to provide a holistic description of the status of the ecosystem; (2) an evaluation of the results in relationship to system-level hypotheses and achieving system-wide Interim Goals; (3) a summary of those changes that are consistent with restoration goals and hypotheses and those that are not; (4) a discussion of why the goals and hypotheses are not being achieved; (5) the identification of major unanticipated findings that may need attention and correction; and (6) information about issues relevant to the CERP AM Program. The combination of a large geographic extent, diverse ecosystems, and multiple report goals creates opportunities for developing key lessons learned on ecosystem health reporting. This presentation will focus on those types of lessons learned that are applicable to other ecosystem restoration programs.

Additionally, the SSR has evolved over time. The first version was developed in 2006 as a test-of-concept to examine the application of the RECOVER Assessment Strategy, specifically focusing on determining whether current sampling designs, data quality objectives, variability, power analyses, and relevant spatial-temporal patterns were sufficient to establish a pre-CERP reference condition. The 2007 SSR was the first comprehensive technical assessment of monitoring data from the MAP as well as other sources. Because the datasets used were limited to only a few years, estimates of the pre-CERP reference condition were uncertain. The 2009 SSR was built on the 2007 assessment – leveraging feedback from the National Research Council, it also identified changes from previous year(s) that were inconsistent with system-wide hypotheses and goals and objectives and for which corrective action is required. The document has also been expanded into a web-based application, which allows users to easily explore the SSR according to their expertise and desired level of detail. The next SSR will be developed in 2012 and will include lessons learned during the last 5 years.

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Integration of Key Scientific Findings for Everglades Restoration in an Interagency Report

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The 2009 System Status Report (SSR) provides an in-depth assessment of monitoring data collected by the Restoration Coordination and Verification (RECOVER) Monitoring and Assessment Plan (MAP). Scientific information collected by the MAP and reported in the SSR is fed into the decision-making process through adaptive management, allowing managers and decision-makers to use the best available science during CERP implementation. In order to make the SSR as relevant to managers as possible, a Key Findings document was developed to integrate only those findings containing the greatest implication for restoration. This 20-page document complements a traditional Executive Summary by providing managers with a brief overview of the science within the SSR, while emphasizing how assessments of system-wide monitoring can assist with tracking effects of project implementation and operational changes.

The development process of the Key Findings document involved not only MAP principal investigators (those collecting the science), regional coordinators (those integrating the science across geographic regions), and system-wide coordinators (those integrating the science across the system), but also agency experts with a management perspective. This latter group was solicited to review the content and format of the document to ensure that the information within is relevant and useful for managers and decision-makers. Preparing such a Key Findings document focused on integrating information, rather than merely compiling or coordinating the presentation of that information.

The Key Findings document is organized by geographic region, MAP hypothesis cluster, and Interim Goals. Interim Goals are an agreed upon subset of the MAP parameters for charting restoration success at specific points throughout the overall planning and implementation process. For each monitoring component discussion, there are three parts: (1) **Key Findings from the SSR** - new scientific findings garnered from the MAP; (2) **2008 Stoplight Indicator** – a comparison of SSR key findings with the status of stoplight indicators as part of the ongoing integration of reporting efforts across south Florida entities; and (3) **Potential Management Relevance** – information that can be used to inform decision-making. This poster will provide lessons learned from Everglades restoration applicable to other large-scale restoration programs in communicating important scientific information to decision-makers.

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The Real World – Merging Science and Engineering for Ecosystem Restoration

Eliza Hines and Katie McCallion

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The Comprehensive Everglades Restoration Plan (CERP or Plan) is an \$11 billion, 30-year plan to restore the Everglades and South Florida ecosystem. The Plan was authorized by the Water Resources Development Act (WRDA) 2000 and includes 68 separable components organized with the overarching goal of restoring quantity, quality, timing and distribution of water in South Florida. WRDA 2000 also included a provision for development of a system-wide science program (Restoration Coordination and Verification [RECOVER]) to monitor and assess the ecosystem and determine whether the goals and objectives of the Plan are being met. Successful restoration requires the integration of comprehensive project planning and design with the use of the best available science. To date, the integration of planning, engineering and science during CERP project planning and implementation has been challenging. These challenges are the result of many factors including: (1) the intricacy of planning, designing, and implementing complex ecosystem restoration projects; (2) the multi-disciplinary, multi-agency, collaborative approach being advocated as part of the CERP Adaptive Management (AM) Program, and (3) the necessary separation of engineering and science in the organizational structure of federal, state, and local agencies.

In an environment where it is not feasible to restore the ecosystem to its historic condition, successful restoration is impossible without bridging this gap between engineering and science. In the ten years since the authorization of the Central and South Florida (C&SF) Project Comprehensive Review Study (Restudy), there have been lessons learned about the integration of planning, engineering, and science. Although often implemented and tracked separately, it's become evident through work done to date that sound science underlies good project planning and design and a project is only successful if it achieves its environmental goals and objectives. The integration of these disciplines throughout the life of the project has been recognized as one of the most important factors contributing to project and program success. Ultimately, CERP projects and the science program must be viewed as one in the same if ecosystem restoration is to be achieved.

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Applying Engineering Solutions to the Science of Invasive Aquatic Species Control – Asian Carp and Sea Lamprey

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Considerable behavioral and physical research is undertaken by universities, agencies, associations and other interested parties to learn more about the behavior of invasive species threatening the native fauna and fish of our inland waters. Invasive species control strategies are developed, modeled and evaluated, with those showing the most potential selected for implementation in our rivers and streams. Scientists and engineers then come together to design and construct the barriers, traps and diversions that scientific research has found to show the most promise. The presentation of several case histories relating to the control of the European Sea Lamprey and the Asian Carp, will illustrate the teaming of science and engineering to transform ideas developed with research into real life solutions in the field.

The sea lamprey is an invasive species in the Great Lakes that preys on native species of fish. Lampreys are the object of an integrated control program implemented in U.S. waters by the U.S. Fish and Wildlife Service as an agent of the Great Lakes Fishery Commission. The program uses a suite of techniques to eliminate or prevent reproduction by sea lampreys including application of selectively toxic lampricides to larval infested waters, trapping of spawning-phase lampreys, release of sterilized lampreys, and construction of barriers to prevent upstream migration of lampreys to spawning grounds. Stanley Consultants has completed designs for several lamprey barrier and trapping structures in the Great Lake tributaries. The program has been successful in reducing sea lamprey populations to about ten percent of pre-control abundance. Continued suppression of sea lampreys is essential to achieve healthy aquatic ecosystems in the Great Lakes.

“Asian” carp include black carp, bighead carp, grass carp, and silver carp; and could potentially threaten the habitat of native fish species in the Mississippi River in Minnesota and its contributing streams and lakes if populations continue to migrate north. Coon Rapids Dam is the furthest downstream dam on the Mississippi without a navigation lock and may represent the last barrier to prevent upstream migration. Stanley Consultants was retained by Three Rivers Park District via a grant from the Minnesota Department of Natural Resources (DNR), to evaluate the dam for its effectiveness as an invasive fish barrier. Behavioral and physical barriers were evaluated, but the dam’s natural characteristics were concluded to offer the most effective and practical barrier solution. Using species swimming and leaping abilities provided by the DNR, barrier effectiveness was determined by modeling the hydraulics of the dam. It was concluded that a change in dam operation could increase barrier effectiveness from 89 percent to nearly 100 percent. Conceptual designs were developed for improvement measures that would extend the dam’s life another 50 years. The study will be reviewed by local, state and federal agencies and may lead to future dam improvements.

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Confronting Climate Change through Restoration - Initiatives of the Department of the Interior's NRDAR Program

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The Department of the Interior (DOI) Natural Resource Damage Assessment and Restoration (NRDAR) program, through its five trustee bureaus and several support offices, collaborates with tribal, state and other federal trustees, to restore resources injured by chemical releases and oil spills. The program currently oversees 154 restoration projects representing over 40,000 acres under restoration, across the U.S. and internationally, in compensation for contaminated lands. It is, thus, well-suited to encourage the incorporation of climate regulating services by including global climate change (GCC) adaptation, mitigation and valuation in the restoration activities it oversees.

Adaptation to ensuing climate change is encouraged through development of diverse habitats with functional redundancy, incorporation of habitat, refugia, and corridors for species impacted by GCC-induced stressors, and habitat development incorporating anticipated changes in water availability, ocean levels and weather intensity. Mitigation measures center on carbon sequestration encouragement and monitoring through revegetation, afforestation, and reforestation to maximize carbon sequestration, both immediate and long term, and soil amendment and management practices to increase carbon sequestration in the soil environment. NRDAR program scientists and collaborators recently participated in a Pellston Conference focused on incorporating GCC into the NRDA process and its subsequent restorations. The conference focused on how GCC will modify chemical availability and exposure at contaminated sites, the mechanisms by which chemicals affect resource targets and how these modifications will be expressed in natural systems being modified by the influence of GCC and restored through the program. A thorough review of this topic is being finalized as a resource for restoration practitioners.

As ecosystem services – provisioning, regulating, supporting and cultural – are routinely quantified, valued, and restored in NRDAR cases, restoration projects that provide cumulative ecosystem services, like the regulating service of carbon sequestration, could increase the value of the project to the public and the responsible party. Though the quantification of regulating services is complex, NRDAR case teams have extensive experience developing relatively reliable analyses of service losses and gains. Once quantified, carbon sequestration from restoration projects could be valued by the market (e.g., restoration banking, carbon markets) or through economic studies as a passive use.

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Landscape Conservation Cooperatives: Working Together to Sustain America's Land, Water, Wildlife and Cultural Resources

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Monumental conservation challenges will be compounded by continued growth in human population and associated land and water use pressures. These challenges will be magnified by the effects of changing climate. Resource management agencies, conservation organizations and other stakeholders must work together to leverage resources and concentrate them where they do the most good. The Department of Interior's (DOI) initiated partners based Landscape Conservation Cooperatives (LCCs) is a bold step in that direction. LCCs are management-science partnerships that inform on-the-ground conservation actions addressing climate change and other stressors within and across landscapes. The LCCs are meant to complement the current science and conservation work of existing partnerships - such as fish habitat partnerships, migratory bird joint ventures and flyway councils - as well as water resources, land, and cultural partnerships. Through LCCs, partners with jurisdiction over fish and wildlife and other resources can coordinate conservation actions with each other and develop decision-support tools to assist resource managers in meeting 21st century challenges.

Each LCC operates within a specific landscape, 21 geographic areas in total. This presentation will discuss the national LCC perspective and then focus in on the Florida LCC as a case study. A core team has been working on forming the Florida LCC. Lastly, this presentation will depict the landscape-level science developed for the Florida LCC which includes alternative futures and statewide habitat and species models.

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Policy and Permitting Recommendations to Promote and Increase the Effectiveness of Submerged Habitat Restoration Efforts in Southwest Florida

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Seagrass and oyster bar habitats have valuable structural and functional components for coastal ecosystems and are currently experiencing worldwide declines. Globally about 29% of the known areal extent of seagrass has disappeared and the rate of decline is accelerating. These systems provide sediment and nutrient filtration, sediment stabilization, breeding and nursery areas for finfish and shellfish, support a complex trophic food web, and a detritus-based food chain. Natural and human-induced events create disturbances in seagrasses and oysters throughout the world. Human activities that most affect seagrass are those like nutrient and sediment loading from runoff and sewage disposal, dredging and filling, pollution, unland development, and certain fishing and boating practices which alter water quality or clarity. In light of all the ecosystem services seagrasses and oysters provide there has been an effort to protect these coastal ecosystems and restore areas that are damaged.

It would then stand to reason that projects wishing to restore these types of submerged aquatic habitats would be supported by all state and federal entities that have jurisdiction over such lands. People on the ground doing the restoration have found that it is actually very difficult and takes an exorbitant amount of time to get the necessary permits to carry out a restoration. In this project we examined existing policy and regulatory programs at local, state, and federal levels that are relevant to the restoration of submerged habitats to determine their limitations (e.g., gaps and loopholes). Key local, state, and federal resource agency personnel, non-profit restoration advocacy organizations, and private business/industry partners that have relevant knowledge to address policy and regulatory limitations were consulted. We then made policy recommendations and suggested strategies to promote and increase the effectiveness of submerged habitat restoration efforts in Southwest Florida. The key players from different agencies and stakeholders were asked to participate in an open dialogue about how to better facilitate restoration projects in Southwest Florida. It is hoped that the outcomes from this project will improve and increase seagrass and oyster habitat restoration throughout South Florida.

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Nationally Significant Ecosystems – Related Efforts in the Upper Mississippi River System (UMRS)

Marvin E. Hubbell

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The Upper Mississippi River has been identified as one of the Nationally Significant Ecosystems. This designation has opened new opportunities between long established programs and partnerships to enhance already high levels of coordination for the UMRS. Discussed will be the early regional and basin responses to this designation, a look into the future opportunities and challenges that it may provide, and the some key ecological characteristics of the UMRS.

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Wetland Restoration on Private Lands: Changing Perspectives and Future Challenges

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Wetland restoration on private lands has gained considerable traction during the last 20 years. The Wetland Reserve Program in particular, with more than two million acres currently enrolled and more than three million acres projected by 2012, represents the conduit by which private landowners have been engaged in wetlands conservation. This and other state and federal programs promoting wetlands conservation on private lands are faced with challenges of learning from experience, acknowledging landowner incentives and barriers to participation, adapting restoration strategies to the unique hydrological and ecological settings, and using available information to perpetuate funding for wetlands conservation.

Restoration strategies have gradually evolved beyond relatively simplistic infrastructure designed to ensure water retention. Continued advancement in restoration design must ensure resource values as well as long-term maintenance of infrastructure. Both hydrological integrity and physical integrity need to be considered in order to restore wetland function and “best fit” within particular landscapes. Yet, engineering and design must continually be adapted to balance near-term cost of restoration with long-term liabilities of operations and maintenance.

In a number of respects, restored basins have advanced beyond the “honeymoon” of initial wetland recovery. On-going management must recognize the altered nature of most landscapes within which restored basins exist. Lacking natural disturbance regimes most basins undergo loss of wetland productivity, increasingly monotypic vegetation, and invasion by undesirable species. In most instances, these trends require active management that emulates wetland dynamics. Landowners often do not have the background to assess wetland conditions, equipment and knowledge to apply solutions, or are absentee and unable to track what often are gradual and “surprising” changes. Technical assistance and a focus on managing existing investments in restored wetlands will become at least as important as adding new ones.

Wetland restoration on private lands is assumed to provide considerable benefits in water quality, water quantity, recreational opportunity, and an offset to continued farming of marginal lands. Although a number of case studies and local or regional evaluations provide useful assessments of these values, greater attention to monitoring will be required to document value and justify continued funding. Among priorities for evaluation are wildlife responses, benefits in ecological goods and services, and incentives and barriers to landowner participation. Structured decision making and more specifically, adaptive management provide a framework for addressing rigorous application of monitoring programs.

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Evaluating Restoration Success and Applying Adaptive Management in the Middle Rio Grande Bosque

Ondrea Hummel

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The U.S. Army Corps of Engineers Albuquerque District (SPA), collaborating with various local partners, is implementing restoration projects in the Albuquerque Reach of the Middle Rio Grande. These projects include removal of metal jetty jacks, debris, and dense thickets of non-native vegetation (salt cedar, Russian olive, and Siberian elm) from the bosque (riparian forest), creation of wet habitats (such as willow swales and high-flow channels), and revegetation focused on increasing wildlife habitat diversity and quality. The goal of these projects is to develop a framework for restoring a more functional and sustainable bosque ecosystem. Feasibility analysis of these restoration components used the Habitat Evaluation Assessment Tool (HEAT) to choose a recommended plan.

Plan development also included development of a Monitoring and Adaptive Management Plan required under Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) to monitor and manage the success of ecosystem restoration. "Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be need to attain project benefits."

Projects implemented on the ground are being monitored for success components including vegetative response, wildlife use and response, and surface water-ground water interaction. This is providing important information for planning future restoration efforts to meet all project objectives. Monitoring has also revealed where improvement is needed and adaptive management can be implemented. This presentation will give an overview of the various projects, use of HEAT modeling and monitoring, and how this can be tied to adaptive management.

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Invasive Species Management in the Southwestern U.S.

Ondrea Hummel¹ and **Nedenia Kennedy²**

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Throughout the South Pacific Division (SPD), the Corps is working on a number of invasive species issues. A number of aquatic invasive species are being managed, including zebra mussel, Hydrilla, and Eurasian water milfoil (*Myriophyllum spicatum*). These aquatic species can interfere with reservoir operations as well as recreation, navigation and ecosystem restoration.

SPD is also working on projects to manage such terrestrial species as giant reed (*Arundo*), salt cedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), Siberian elm (*Ulmus pumila*), Tree of Heaven (*Ailanthus altissima*), and various weed species (cocklebur, Russian thistle, perennial pepperweed, Russian knapweed, and yellow star thistle). The majority of these terrestrial species are phreatophytes that compete for water resources, out-compete native vegetation, change soil characteristics, have effects on threatened and endangered species, and negatively affect the Corps' mission.

Examples of projects addressing these and other species will be discussed. Coordination between SPD and the Invasive Species Leadership Team (ISLT) for information sharing, coordination and lessons learned will also be discussed. Such lessons include design of restoration projects to include comprehensive management of invasives before installation or construction of restoration features.

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Post-Construction Analysis of Sediment Transport in Millers Creek

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The potential success or failure of a river restoration project is highly dependent on sediment transport. Aggradation, degradation and erosion of the streambanks are processes by which restoration projects can fail. Understanding and predicting sediment transport within a restoration project can be a complex process, especially when instream structures are proposed. Following construction of the Millers Creek Stabilization Project, a rain event produced flows that mobilized (and deposited) substantial material within the project reach leading to removal of two of the five installed cross vanes. A post-construction evaluation, using a simple one-dimensional model (HEC-RAS) and basic sediment transport calculations was completed to determine if basic modeling tools could have predicted the observed sediment transport. Velocity measurements obtained in the restored reach confirmed that HEC-RAS does not accurately capture the localized flow dynamics in the immediate area of the cross vane. Comparison of average measured velocities to the model predicted average channel velocity indicated that cross vanes could be represented in HEC-RAS using an obstruction, rather than multiple cross sections with reasonable accuracy in identifying reach-wide trends.

The basic sediment transport calculations did not provide a good mechanism for predicting for the quantity and size of sediment that was deposited in various areas within the restored reach. However, the basic calculations predicted overall sediment transport trends within the reach, including identifying areas where deposition would be expected. Additionally, the modeling effort indicated that cross section geometry variations associated with normal construction practices could impact stream hydraulics and sediment transport more than an in-stream structure. In this case, failure (by deposition) of one cross vane might have been predicted by this analysis, but failure of the second cross vane (by deposition) would not have been predicted. While a HEC-RAS model and basic sediment transport calculations can provide some insight for predicting sediment transport processes within a restored reach, the limitation of these tools for predicting the complex sediment transport process should be recognized when used as a design tool.

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Successful Restoration – Understanding the Importance of Technical and Social Elements

Zachare Ball and John O'Meara – presented by **Lisa Huntington**

Environmental Consulting & Technology, Ann Arbor, MI, USA

A successful urban stream revitalization project must incorporate a variety of disciplines, including environmental, engineering, economic and social aspects. This paper discusses the synergy between project engineering, environmental considerations, project cost and community involvement by discussing efforts made to foster public interest in and access to two urban waterways habitats located in the Rouge River Watershed.

The Rouge River Watershed is home to more than one million people and encompasses 467 square miles, running through the most densely populated and urbanized land area in southeast Michigan. The river's four branches total approximately 126 miles of waterways and include over 400 lakes, impoundments and ponds. More than 50 miles of the river flows through public parklands, making the Rouge River one of the most publicly accessible rivers in the country. The watershed has been the subject of intense restoration efforts since 1992. As part of that effort, two projects were completed that have had a significant impact on the system: Newburgh Lake in the Wayne County Parks system and the Oxbow at the Henry Ford in Dearborn.

Newburgh Lake is a 105-acre impoundment that had diminished recreational capacity due to the accumulation of sediments with elevated levels of contaminants. Established objectives for this project included restoration of water quality; elimination of the fish consumption advisory for PCBs; increased numbers and diversity of aquatic life; increased use of the lake, and restoring the public perception of the lake as a recreational and educational resource. During the project, a public education program was developed which included making presentations to nearby elementary schools and conducting tours of the construction site. This allowed the public to rediscover the lake they had abandoned and encouraged continued citizen involvement.

The Oxbow was cut off by a concrete channel installed as a flood control project along the Rouge River in approximately nine miles of the original river channel, which cut off several river meanders and creating several shallow oxbow wetlands. The main objective of the Oxbow Restoration Project was to enhance the ecological viability of this western-most Oxbow by creating valuable fish and wildlife habitat and restoring functioning riverine wetlands that had been lost due to the channelization. Upon project completion, the Henry Ford developed an educational and interpretive program associated with the oxbow upland and related curriculum was incorporated at an onsite elementary school.

In summary, urban stream restoration projects require that the social aspect of a project be considered as value-added to the engineering, environmental, and economic considerations.

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“Natural” Riverine Recovery Following Dam Removal

Michael Chelminski and *David Huntress*

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The lower dam (Montsweag Dam) on Montsweag Brook in Wiscasset and Woolwich, Maine, was removed in 2010, which resulted in the re-establishment of approximately 4,800 feet of stream channel through the former impoundment. No structural measures were used for stabilization of the former stream channel as part of this project except for seeding of dewatered riparian zone prior to dam removal construction. This talk presents information on the recovery of the channel in the absence of structural stabilization measures over a period of one year following dewatering and dam removal.

Montsweag Dam was built in 1968 as a backup water supply for the Maine Yankee nuclear power generating facility, had a hydraulic height of 22 feet, and created a 20 acre impoundment. The dam was located approximately 1,000 feet upstream from the head-of-tide and had no facilities for upstream fish passage. As part of the 2008 Natural Resources Damages Restoration Plan and Settlement Agreement between Maine Yankee and the State of Maine, ownership of the dam was transferred to a local conservation group; this transfer included a requirement that the recipient evaluate the feasibility of re-establishing fish passage at the dam. A feasibility study completed in late 2009 by Stantec determined that dam removal would be the least expensive and most effective approach to achieve fish passage and would also afford an opportunity for restoration of riverine and riparian conditions through the former impoundment.

Bathymetric and sediment probe survey work indicated the presence of relatively steep-side slopes blanketed by an approximately 1-foot thick layer of fine-grain sediments, with a deposit coarse grained material mixed with woody debris/detritus located near the head of the impoundment. Treatment of riparian areas dewatered during pre-removal impoundment drawdown was limited to seeding with a native, herbaceous seed mix due to limited access for construction equipment, with the objectives of reducing potential for erosion of valley side-slopes and to inhibit invasive plant species colonization. Design and permitting for dam removal were completed in mid-2010, and the impoundment was drawn down in the summer of 2010 prior to initiation of construction in September 2010. Dam removal construction was completed in early November 2010.

Formerly aggraded material was allowed to naturally mobilize from within the 15- to 25-foot wide stream channel and re-distribute downstream during controlled dewatering of the impoundment. Two natural high flow events that occurred late during the construction sequence increased the rate of material redistribution, exposing native alluvial substrates along approximately half of the formerly impounded reach of channel. It is expected that seasonal high flows during the spring of 2011 will continue to expose alluvial substrates throughout much of the balance of the channel.

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Restoration of Buckhorn Creek through the Removal of 100-year old Hydro-electric Generating Facility

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Stantec was retained to provide survey, design, permitting, construction and post-construction monitoring for the removal of the Buckhorn power generating facility and dam and restoration of Buckhorn Creek. The facility was constructed in 1903, decommissioned in the 1960's and represented an impediment to the flow of Buckhorn Creek. The design consisted of the installation of log step pools to provide grade control and energy dissipation in the steep tributaries as well as rock cross vanes and woody debris toe protection in the main channel to provide grade control, bank protection and fish habitat. The old channel was converted to a wetland to provide habitat and water quality benefits.

Construction sequencing was critical to the success of the project. A portion of the dam was removed to allow for the creation of a temporary diversion channel which conveyed the flow in Buckhorn Creek while the remainder of the structure was demolished. Once the concrete structures were demolished and removed and water levels lowered, more than 1,000 feet of the upstream channel as well as two tributaries totaling 700 feet were stabilized using natural channel design techniques.

Construction took place in the fall of 2009. Challenges during construction included more than 31 inches of rain and flows in excess of 800 cubic feet per second. Stantec is currently under contract to Progress Energy to provide 5 years of post-construction monitoring of geomorphic conditions and channel stability. To date, the project has performed well requiring only minor maintenance to remove cattails from one of the tributary channels. Buckhorn Creek now flows unimpeded to the Cape Fear River. It has created habitat for the endangered Cape Fear Shiner and more than \$600,000 worth of Stream Mitigation Credits if Progress wishes to pursue them.

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Conceptualizing and Communicating Ecological River Restoration

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We present a general conceptual model for communicating aspects of river restoration and management. The model is generic and adaptable to most riverine settings, independent of size. The model has separate categories of natural and social-economic drivers, and management actions are envisioned as modifiers of naturally dynamic systems. The model includes a decision-making structure in which managers, stakeholders, and scientists interact to define management objectives and performance evaluation. The model depicts a stress to the riverine ecosystem as either a) deviation in the regimes (flow, sediment, temperature, light, biogeochemical, and genetic) by altering the frequency, magnitude, duration, timing, or rate of change of the fluxes, or b) imposition of a hard structural constraint on channel form. Restoration is depicted as naturalization of those regimes or removal of the constraint. The model recognizes the importance of river history in conditioning future responses. Three hierarchical tiers of Essential Ecosystem Characteristics (EECs) illustrate how management actions typically propagate through physical/chemical processes, to habitat, to biotic responses. Uncertainty and expense in modeling or measuring responses increase in moving from Tier 1 to Tier 3. Social-economic characteristics are shown in a parallel structure that emphasizes the need to quantify tradeoffs between ecological and social-economic systems. Performance measures for EEC's are also hierarchical, showing that selection of measures depends on participants' willingness to accept uncertainty. The general form is of an adaptive-management loop in which the performance measures are compared to reference conditions or success criteria and the information is fed back into the decision-making process.

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Legislative Drafting Service Fundamentals for Ecosystem Restoration Projects

Herman H. Jarboe

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So you get a call from your Chief letting you know the District had a legislative drafting service request from a senator for an ecosystem restoration project, and they wanted it yesterday!!! Your Chief wants you to get er' done. Problem is you have never written draft legislative language before so "What are you going to do"? It is important to remember that before the most elegant Corps of Engineers ecosystem restoration project can be studied or constructed, it must first be authorized in law. Obtaining authority is the guiding principle in the political process. The authorization process provides the legislative authority and congressional direction for Civil Works programs, studies and projects. Good draft legislative language can help to avert much confusion later in regards to interpretation of congressional intent and development of implementation guidance. Effective and accurate draft legislative language must be a team product and that team should include seasoned planners from a Planning and Policy organization and lawyers from the Office of Counsel. Lawyers have the ability to interpret law, are familiar with legal jargon, and maintain the knowledge to ensure any language drafted is consistent with existing law. Planners contribute to the process by knowing the Corps of Engineers Civil Works program and planning process.

It is important to understand that there is no single way to write draft legislative language, only that it be clear and succinct since the purpose of the language is to communicate Congressional intent. Format for legislative language can vary widely among authors. Elements, depending upon the purpose of legislative language, can include but are not limited to a description of: location, a plan of action, credit provided, participating parties, costs and cost-sharing, authorization of appropriations, operation and maintenance responsibilities, and lastly applicability or integration with existing authority or previous legislation. Sometimes the best way to develop legislative language is to examine language that is already in law, for example a previous Water Resources Development Act. There is no need to reinvent the wheel, so borrow shamelessly. In most cases, requests to develop draft language, as you have already found out, come under circumstances where there is very little time available to produce, so having several "go-bys" available can certainly help facilitate the process. Another recommendation would be to get a patient mentor to help guide you through the process. Lastly, remember what you are drafting is language that may eventually become law. Final review of the draft language by Office of Counsel and coordination with Division and Headquarters must be the last step prior to release of the draft language to the senator.

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Chesapeake Bay Ecological Atlas

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The Chesapeake Bay Ecological Atlas will provide the foundation for discussions on how to preserve and restore the Bay. In the same way that surgeons must understand the human body before operating, we must understand where things are in the Bay and how they function together. Like a general anatomy guide for the Chesapeake Bay, this Atlas takes 25 years of data and presents the analyses in a highly visual, descriptive form.

The Atlas will be an important reference guide for citizens, scientists, and decision-makers. The Chesapeake Bay is one of the most studied estuaries in the world, but the wealth of data remains distributed and not easily accessible in any summarized format.

The Atlas will help users understand how the Chesapeake Bay ecosystem operates. It will explain in plain language how the geophysical setting, climate and atmospheric conditions, hydrodynamics, and land use work together to determine water quality, habitat, and food web dynamics. The relationship between humans and our environment is reciprocal, and the Atlas will address humans' role in both stressing the system and in managing, restoring, and using the Bay.

A major contribution of the Atlas is that the integration of hydrology and climate allow us to show human induced and natural annual variability. Natural variability can be a large component of either meeting or failing to meet ecosystem management goals, yet its influence is not often considered when setting restoration and protection targets. By synthesizing this information, the Atlas has the potential to alter the discussion and improve goal-setting.

The Atlas will provide a readily accessible common framework among Chesapeake Bay managers and scientists. This information can inform critical decisions, such as where to site habitat restoration activities, oyster reef placement, criteria assessment, and goal attainment decisions.

NOAA's National Center for Coastal Ocean Science (NCCOS) is leading the development of this new product. NCCOS is partnering with regional academic, private industry, and non-profit partners to ensure the broadest range of expertise is included in the Atlas. The project began in early 2011 and a draft is expected to be complete by August.

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Training Range Environmental Evaluation and Characterization System (TREECS) Development and Application

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Active military ranges contain munitions constituents (MC) and metal contamination that affect the usability and functionality of training facilities. Residues and disturbances from range operations can adversely impact the environment, including human and ecological health, which require a variety of assessment tools to evaluate. Such impacts can also affect environmental compliance and range sustainment. Most Army live-fire training and testing ranges also have unique environments in which low-order and dud munitions may cause random and highly uncertain sources of MC contamination. Additionally, these ranges are under increased regulatory scrutiny, which in extreme cases has resulted in limitations being placed on training. The Training Range Environmental Evaluation and Characterization System (TREECS) has been developed by the Engineer Research and Development Center (ERDC) to assist Army analysts in managing ranges in such a manner that comply with environmental quality (EQ) objectives for toxic constituent stressors. The system hosts environmental characterization, risk management and evaluation tools and integrates the results for ease-of-use and reliability for MC. Specifically, the system automates conceptual model formulation and model parameter population across scales and pathways; formulates and couples first principle MC fate/transport-transformation-sequestration models with hydraulic models; and provides a single tool that bridges the gap between migration assessment and risk management and range sustainment. TREECS is currently being tested for use in the Army's Operational Range Assessment Program (ORAP). This presentation will discuss the overall TREECS framework and capabilities along with a case study demonstrating those capabilities.

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The Red River of the North: Habitat Restoration in a Broad Floodplain

Lorin K. Hatch¹, Nate Dalager¹ and Tim Fobes² – presented by **Dave Johnson**

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In the early 1900s mechanized agriculture transformed the Red River of the North Valley (Minnesota, North Dakota, Manitoba) tall grass prairies into endless fields of wheat and other crops. Given the flat topography of the area, significant agricultural drainage was constructed to handle excess water, draining and eliminating large blocks of terrestrial and aquatic habitat. These drainage efforts, however, were ineffective when significant Red River floods spread across hundreds of square miles.

A recent approach to both flood damage reduction and aquatic ecosystem restoration is the creation of dry impoundments. These earthen dams and structures capture spring and summer runoff in order to slowly release the flood waters after the flood peak has passed. As a result of the success of this approach, mitigation within the impoundments, as well as restoration of the outlet channels has become more commonplace. In this talk we will present the overall approach to flood damage reduction in the Red River Valley, how this approach creates opportunities for ecosystem restoration, and provide examples of resulting restoration efforts.

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National Research Council Evaluation of the Chesapeake Bay Program's Nutrient Reduction Program

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Starting in 2009, the Chesapeake Bay Program (CBP), led by the U.S. Environmental Protection Agency (USEPA), launched a new and aggressive multi-state strategy to reduce the loading of nutrients and sediment to the Bay to increase the pace of restoration progress. Central to this program are the two-year milestone commitments from each state, which are integral steps toward reaching the newly released Total Maximum Daily Load (TMDL).

A National Research Council committee is nearing completion of a 21-month review of the Chesapeake Bay Program's nutrient reduction program to improve water quality, sponsored by the USEPA. The report, expected to be released in April 2011, will examine the CBP's two-year milestone strategy and implementation as a means to reach the nutrient and sediment reduction goals. In its report, the committee also evaluates the tracking and accounting efforts that are used to monitor the implementation of best management practices and, thereby, determine the progress toward meeting the CBP goals. The committee evaluates the adaptive management strategies being developed by the CBP and the Bay states and discusses the most appropriate and useful applications for adaptive management in the Chesapeake Bay watershed. The report also offers recommendations for improvements to the nutrient reduction strategies to help increase the likelihood of achieving the goals.

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Geomorphological Interpretation of High Resolution DEMs from the GIS Desktop: A Case Study in Locating Sediment Sources to Lake Forest Lake, Baldwin County, Alabama

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The recent advent of high resolution (<2m grid) Digital Elevation Models (DEM) now makes it possible for the geomorphologist to locate features of interest before entering the field. Locating sediment sources during lake, stream, and watershed assessments frequently includes a field component in which geomorphologists and environmental scientists explore the watershed through streamwalks, lake shoreline surveys by boat, and windshield surveys with a goal of locating points of severe erosion or other interests that potentially impair water quality or watershed health. This time spent exploring is precious due to the high cost of putting personnel in the field. Often project budgets are insufficient to allow field personnel to adequately walk all the stream miles in a watershed, or the watershed is simply too large to completely explore. Current methods of designing field investigations include using USGS topographic maps, GIS data layers, and aerial photographs to locate and provide a cursory evaluation of perennial streams, lake shorelines, and other features of interest. These methods can overlook features hidden by tree canopy or that are not represented on topographic maps or the GIS data. With the advent of LIDAR data, one- to two-meter DEMs can now be produced that allow geomorphologists to generate slope maps and contour maps that can be interpreted in terms of geomorphic features previously observable only during field investigations. Features that are observable with a high resolution DEM include but are not limited to: steep stream banks, eroding shorelines, escarpments, mass wasted materials, headcutting gullies, culvert headwalls, abandoned terraces, dredging spoils, retaining walls, old areas of earth moving and cut and fill activities, and the exact location and pattern of stream channels. This enables the geomorphologist locate features on that might have otherwise been overlooked during a traditional field investigation. However, the cost of LIDAR is typically prohibitive for widespread data collection and is not available in many areas. Cities and counties that serve moderately large populations have the budget allotments to collect LIDAR data, and often do so to meet planning and development needs. When available, LIDAR is an excellent tool that allows geomorphologists to develop more efficient plans for how time is spent in the field, thereby adding greater value to watershed assessment efforts.

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Estuarine Restoration in San Francisco Bay: Design and Adaptive Management

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The San Francisco District of the U.S. Army Corps of Engineers (USACE) is one of several agencies working together to reverse the trend of wetland loss in the Bay estuary by restoring large areas of former tidal salt marsh. The USACE is the federal lead agency on several large scale estuarine wetlands restoration projects which are at varying stages of completion.

The Hamilton Wetlands Restoration Project (HWRP) is approximately 1,000 acres of estuarine and seasonal wetlands currently under construction. The dredged material placement component of the project constituting 7.0 million cubic yards has been completed. When complete, the project will support a mosaic of tidal wetlands, seasonal wetlands, and uplands.

The planning, design, and adaptive management plan have been developed in part based on lessons learned from the Sonoma Baylands Project, another USACE wetlands restoration project based on beneficial use of dredged material. These center around several project objectives, the main of which is to maintain habitat for the federally endangered California clapper rail and salt marsh harvest mouse, shorebirds, and estuarine fish species.

Information from Sonoma Baylands was used to predict tidal marsh evolution rates and optimal tidal connection design dimensions. Similarly the adaptive management plan for HWRP drew upon monitoring data and lessons learned from Sonoma Baylands.

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Reservoir Sedimentation: Linkages to Ecosystem Restoration

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The impacts of reservoir sedimentation can extend considerable distances upstream and downstream, influencing channel morphology, stability, and ecological health. This underscores the need to develop ways to effectively manage sediments from a systems perspective while also seeking to extend the effective and economic lives of reservoir projects. Within the United States, the Corps of Engineers (COE) maintains 609 dams, of which 383 of those dams and reservoirs are operated for flood damage reduction. Thousands of other lakes are operated and maintained by various Federal, State, and local entities. In the course of normal operations, reservoirs trap sediment and eventually fill. This sediment deposition reduces the useful life of the reservoir and can severely impact authorized project purposes. Significant problems may occur when even a small percentage of volume is lost to sediment. Although the reduction of reservoir capacity caused by sediment deposition is the most obvious impact, the ecological impacts of reservoir sedimentation are significant and extensive. This presentation will outline the linkages between reservoir sedimentation processes and ecosystem restoration.

Sediment deposition in reservoirs may cause ecological impacts in channel reaches upstream and downstream, as well as within the reservoir itself. Sediment deposition reduces the storage available for low flow augmentation or other flows related to ecosystem function. Sediment trapping within reservoirs often causes channel incision and bed armoring downstream of dams. Deposition at the upstream end of the reservoir and at the mouths of tributaries may impede fish access to upstream reaches. Sediment management measures (such as flushing, sluicing, and bypassing) have associated consequences, both positive and negative, on the channel network, changing channel morphology and substrate composition. Watershed sediment management may be desirable as part of an ecosystem restoration project, in addition to its benefits in maintaining reservoir capacity. Impacts and benefits of various alternatives are often complicated by the presence of multiple projects and activities within a watershed, as well as by the changes in processes over time. To achieve maximum benefits, a comprehensive systems approach to watershed sediment processes is essential. An accurate knowledge of reservoir sedimentation is a critical component of the systems approach.

Research and development work is underway that includes assessing the extent of reservoir sedimentation problems within the Corps; developing a standard database of reservoir sedimentation information; and developing and demonstrating assessment methodologies for Corps reservoirs. This information is pertinent to ecosystem restoration initiatives across the nation.

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Use of an Algal Treatment System for Water Quality Improvement along the Susquehanna River

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A number of best management practices are being tested for improving water quality in the Chesapeake Bay watershed. In this presentation the performance of experimental algal growth beds for nutrient removal and oxygen production was examined along the Susquehanna River in southeastern Pennsylvania. The study was conducted at Exelon Energy Corporation's Muddy Run hydroelectric power facility from June 2008 to October 2009. Periphytic algae were grown attached to screens in shallow troughs in the experiments. Water from the river was pumped over the algae and they absorbed nutrients and released oxygen during their growth. Weekly harvests of algal biomass removed nutrients from the water and stimulated regrowth dynamics of the algae. The systems were dominated by filamentous diatoms and green algae with a high diversity of species that colonized the screens from the river water. During the growing seasons of the study period net biomass production averaged 12 – 14 grams dry weight per square meter of screen surface per day. Nutrient removal rates were calculated by multiplying net biomass production by nutrient contents and were found to be on the order of 3 grams of nitrogen and 0.3 grams of phosphorus per square meter of screen surface per day. Oxygen production varied seasonally from 3 to 33 grams of dissolved oxygen per square meter of screen surface per day. Based on these data and results from other experiments with these algal systems, the potential use of algal growth beds for water quality improvement at the watershed scale is discussed.

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Restoration Opportunities Spurred by Steelhead Recovery in Southern California

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Urban pressures and demands continue to strain resources of southern California rivers, creeks, and estuaries. What can be done to improve watershed health? This session will look at how recovery of federally endangered Southern Steelhead Trout (*Oncorhynchus mykiss irideus*) are spurring ecosystem restoration opportunities in southern California through integrated watershed approaches.

The State of California is implementing Integrated Regional Water Management statewide encouraging regional and watershed-based solutions to water shortages, impaired water quality, and degraded ecosystems. Concurrent with this statewide initiative is the National Marine Fisheries Service's program to recover endangered steelhead trout in southern California. Recovery of this target species focuses on identifying limiting factors to recovery and designing, engineering, and constructing improvements to streams and estuaries to provide suitable habitat for steelhead. Since steelhead habitat support multiple species and healthier ecosystems, southern California water managers and watershed leaders are discovering the benefits of working together to solve tough water and land management issues. Critical watersheds span the entire southern California coast from Santa Barbara to San Diego counties.

Significant restoration opportunities exist in the San Juan Creek Watershed, located in Orange County, California. San Juan, Trabuco, nearby San Mateo, and San Onofre Creeks all had consistent steelhead runs up until at least the late 1940's. The decline in steelhead is a result of: agriculture, mining, urban development, migration barriers such as the Trabuco Creek at Interstate 5 culvert, degraded stream habitat, decreased stream flow, and degraded water quality. Currently, the San Juan Creek Estuary (Estuary) is highly impacted by sediment loading without natural flushing to the ocean and cannot sustain plant and macroinvertebrate communities necessary for a functioning and productive ecosystem. Restoration of the Estuary will include the design and construction of restoration projects including sediment removal, alteration of existing instream structures and installation of new structures to address sedimentation and bank stabilization issues, creation of refugia in the form of pools and backwater areas to address flow velocity and depth problems from channel alteration, and native plantings instream and in riparian areas to restore wetland habitat for native fish and wildlife. Design of upstream restoration projects, including the Metrolink and Interstate-5 fish ladders will restore fish passage to spawning grounds. This presentation will describe steelhead recovery and ecosystem restoration in this significant coastal watershed based on the findings of the San Juan and Trabuco Creeks Steelhead Recovery Watershed Management Plan (CDM, 2007).

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Roadmap to Large-Scale Ecosystem Restoration in the Arroyo Seco Watershed

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A primary goal of the Arroyo Seco Watershed Assessment (ASWA) is to

- Outline projects which address the needs of the Arroyo Seco Watershed.
- Provide a road map for future coordination and collaboration with the U.S. Army Corps of Engineers and other agencies to implement Arroyo Seco Greenway projects by way of a governance structure—the Arroyo Seco Greenway Agreement.
- Provide a framework for future integration of transportation, energy, water resources, and restoration concerns in the development and rehabilitation of the Arroyo Seco Watershed.

Based on adopted plans, stakeholder input, and evaluation of watershed needs and priorities in relation to the four ASWA restoration goals, top tier restoration projects were identified. These projects are described in a sequence that starts at the top of the watershed (e.g., Hahamongna or Upper Arroyo Seco watershed), extending down through the central Arroyo Seco, and finally to the confluence of Arroyo Seco and Los Angeles River. The phasing of these projects follows this top to bottom approach given opportunities to implement "quick-hit" projects in the upper watershed where readiness to proceed is high and restoration needs are also high due to Station Fire impacts to native vegetation and wildlife and water resource management needs in the Raymond Basin. Watershed improvements, following a top down approach yield better long term return on investment as upstream improvements can benefit downstream conditions.

The Upper Arroyo Seco Channel Restoration project is an integrated recreation, water resource, and habitat enhancement project that extends from the Jet Propulsion Lab (JPL) bridge upstream to the headwaters in the San Gabriel Mountains that will improve water supply, recreation, water quality, and ecosystem health. The Upper Arroyo Seco Channel Restoration project is a culmination of years of grassroots planning efforts and analysis focusing on southern California ecosystems. Above the JPL bridge, the primary habitat disruptors are impediments to fish passage, forage, rearing and spawning including anthropogenic structures such as road crossings and water supply diversion and flood control dams. The Central and Lower Arroyo Restoration projects will continue aquatic and upland habitat restoration efforts. Meandering through neighborhoods along the Arroyo Seco, the Lower Arroyo Linkages will provide safe pedestrian and cycling links in the highly urban lower reaches the watershed. ASWA implementation will involve restoration of endangered riverine and upland ecosystem communities including, Riversidian Alluvial Fan Sage Scrub, Southern Sycamore Riparian Woodland, Streambed Riparian, Mule Fat Scrub, Southern Willow Scrub, and Coast Live Oak Woodland.

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Not All Loads Are Equal: Assigning Regional Pollutant Reductions in a Multi-State TMDL

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The establishment of a multi-jurisdictional, first-of-its-kind TMDL, such as that for the Chesapeake Bay, required the development of innovative solutions to unprecedented issues. For example, the relative impact of pollutant inputs from thirty different state basins had to be determined in order to fairly allocate required pollutant reductions to each jurisdiction. Here we describe a novel method that was developed for determining the relative effectiveness of load reductions from different regions for improving water quality (specifically, dissolved oxygen concentrations) in the Chesapeake Bay.

Depending on characteristics such as distance from the affected estuary, length of river, position along the estuary's shoreline, and location of the river's fall line, the relative impact of pollutant inputs from different river basins on a downstream estuary can vary considerably. To address this issue, a measure of "relative overall effectiveness" was developed. This method combines the use of modeling and analytical tools with stakeholder-negotiated decision rules to set the parameters by which necessary reductions are allocated to each region of the watershed.

Two theoretical modeling scenarios – a "No Action" worst case and an "Every Action" best case estimate of total loads to the estuary – were used to identify the maximum theoretical controllable nutrient load reduction possible for the Chesapeake Bay estuary. Rules were then derived, with stakeholder input, to set constraints on the minimum and maximum degree of load reductions, or "level of effort," to be required from each jurisdiction. Limit-of-technology constraints on load reductions were factored into the maximum reduction levels. Within the pre-defined range of effort levels, each river basin was then assigned a proportion of the overall necessary load reduction (identified in a separate process) according to its Relative Effectiveness Score.

This process resulted in a more equitable distribution of load reductions across multiple states and river basins. Moving forward, it also provides a useful tool for targeting future implementation of management actions in those regions where reductions will have the greatest impact on estuarine water quality.

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The Effects of Conservation Practices on Environmental Quality in the Upper Mississippi River Basin

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The Conservation Effects Assessment Project (CEAP) released a final report on the effects of conservation practices in the Upper Mississippi River Basin in June of 2010. Earlier drafts of the report were influential in establishing the need for the Mississippi River Basin Initiative. The report does the following:

1. Evaluates conservation practice use in the region in 2003-2006
2. Estimates the effects of conservation practices in use in 2003-2006
3. Estimates remaining conservation treatment needs
4. Estimates potential gains with additional conservation treatment

The purpose of this presentation is to summarize the key findings of the report. Overall, it was determined that good progress had been made in reducing sediment, nutrient, and pesticide losses from farm fields through conservation practice implementation in the region, but a significant amount of conservation treatment remained to be done to further reduce nonpoint agricultural sources of pollution.

- 39 percent of cropped acres have a **low** level of need for additional treatment and were considered to be adequately treated.
- 15 percent of cropped acres have a **high** level of need for additional conservation treatment; acres with a “high” level of need consist of the most vulnerable of the under-treated acres with the least conservation treatment and have the highest losses of sediment and/or nutrients.
- 46 percent of cropped acres have a **moderate** level of need for additional conservation treatment; acres with a “moderate” level of need consist of under-treated acres that generally have lower levels of inherent vulnerability and/or have more existing conservation practice use than acres with a high level of need.

The most critical conservation concern in the region is the need for complete and consistent use of nutrient management—appropriate rate, form, timing, *and* method of application. Nearly all the under-treated acres require additional nutrient management to better control nitrogen and/or phosphorus loss from fields.

Use of soil erosion control practices is widespread, with most acres (96 percent) receiving some form of conservation treatment consisting of conservation tillage, buffer or filter practices, overland flow control practices, or concentrated flow control practices. Nevertheless, about 10 percent of the cropped acres are under-treated with a high need for additional erosion control.

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Setting Salinity Targets for Restoration in South Florida's Estuaries

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A primary goal of the Comprehensive Everglades Restoration Plan (CERP) is to restore more natural hydrologic and ecologic conditions to the wetlands and estuaries of South Florida. For the estuaries, this means restoring the quantity, timing, and distribution of freshwater that is delivered to Biscayne Bay, Florida Bay, the southwest coast, and the Ten Thousand Islands. The Southern Coastal Systems (SCS), a component of the CERP Restoration, Coordination, and Verification (RECOVER) inter-agency group, is responsible for integrating landscape and CERP components to maintain a system-wide view of the CERP within its boundaries.

One of the unique and important products that emerged from the 2009 Systems Status Report (SSR) was the evaluation of CERP's SCS salinity performance measure (PM) using both empirical monitoring data to assess the current condition, and model output to compare the predicted restored condition to the PM target. This work successfully linked for the first time the assessment and evaluation components using a single RECOVER performance measure, and it was regarded as ground-breaking work by RECOVER managers. The use of one set of performance measures that can handle both the evaluation and assessment components yields output in a common physical or ecological "currency" which is helpful to managers for planning restoration and adaptively managing the system.

While the work described above represented an important linkage of evaluation and assessment components, it also revealed flaws in the SCS salinity performance measure—including: too complex and confusing metrics, multiple, sometimes conflicting targets, and redundancies in target properties. Additionally, Principal Investigators, who conduct ecological monitoring funded by the RECOVER Monitoring and Assessment Plan (MAP) in the SCS, have repeatedly expressed the need for restoration salinity targets in order for them to appropriately revise the ecological PMs. Revision to the ecological PMs is anticipated to allow consistent evaluation of the ecological PMs with the salinity PM.

A sub-team was convened in early 2011 consisting of representatives from multiple federal, state, local agencies and Native American tribes to come to consensus on restoration salinity targets for the SCS. The goal of this sub-team was to establish restoration salinity targets for each estuary on which to base the CERP SCS PMs. This presentation will describe the process utilized and the results from this team's efforts.

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Taylor Slough – An Example that Operations and Flow Can Effect Changes in the Everglades and Florida Bay

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The negative ecological changes observed in the southern Everglades and Florida Bay in the late 1980s and early 1990s led to concerns about water and natural resource management in south Florida culminating in the Comprehensive Everglades Restoration Plan (CERP). The operational control of freshwater flow had reduced the volume of stored freshwater within the natural Everglades system changing hydroperiods and hydropatterns in the marshes and causing the salt/freshwater transition zone to migrate landward into the marshes. The changes are believed to have contributed to a widespread collapse of the seagrasses in Florida Bay in the fall of 1987, the collapse of wading bird nesting in Everglades National Park, and other negative habitat and species related changes. Freshwater inflow from the Everglades into Taylor Slough was modified in 1993 through management of a canal structure and positive differences in the freshwater and brackish water marsh systems and stabilization of salinity in Florida Bay was demonstrated. Salinity data collected since 1955 clearly showed that Florida Bay, which had been shown to most strongly correlate with precipitation (and evapotranspiration), benefited from increased freshwater flow with the reduction in hypersalinity events. After 2005, a series of drought years mixed with years of high hurricane activity demonstrated the difficulties in maintaining operations in the Everglades without a clear plan for storage of water within the system. Because flows into Florida Bay have not consistently changed since the 1987 collapse of seagrasses, the current pattern in the regrowth of seagrass within areas of Florida Bay indicates that the potential exists for a similar collapse event in the future. Evidence of that occurred after 2005 with die-off events. Seagrass data in the transition zone showed expansion of the freshwater and brackish water plant assemblages with higher freshwater flows into this zone from the start of data collection in 1995 until the 2005 reporting. Those assemblages disappeared after 2005. Increased freshwater flow in some parts of the mangrove estuaries of northern Florida Bay has resulted in higher abundance and biomass of small-bodied freshwater taxa, and thus some recovery of the demersal forage fish community for piscivorous fishes and wading birds (e.g., roseate spoonbills). Current attempts to model the amount of flow needed to achieve salinity and seagrass community targets in Florida Bay indicate that two to three times the current average flow is required to meet these targets, which is consistent with the paleo-based evaluations.

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Adaptive Management of Sediment in Rural Watersheds: Evaluating the Worth of Monitoring and Research Using Bayesian Inference and Multi-Objective Programming

Sarah K. Jacobi¹, Se Jong Cho², Benjamin F. Hobbs² and Peter R. Wilcock² – presented by **Melissa Kenney**

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Accurate assessment and effective implementation of nonpoint pollution controls requires choices among many complex and uncertain alternatives. In the case of sediment, large uncertainties in the location and magnitude of nonpoint sources and the effectiveness of alternative controls make planning difficult. In addition, the multiple environmental, economic, and social objectives of the many stakeholders involved must be taken into account.

Uncertainty can be reduced by a variety of research actions: flow and concentration monitoring, sediment fingerprinting, and sediment source analyses combining aerial photography, field work, and literature reviews. Information from such monitoring and research efforts can help managers focus sediment control efforts, resulting in more reductions and cost savings. However, monitoring and research can also be costly and result in delays in clean up and project implementation itself can contribute to improved understanding. We propose and demonstrate an approach to evaluate the tradeoffs between the benefits of information, in terms of improved and less costly sediment management plans, and the cost of acquiring that information. The methodology is based on a Bayesian inference framework that updates beliefs about location, mechanism, and magnitude of sediment loadings using new information. A multi-objective optimization approach then selects the most cost-effective Best Management Practices (BMPs), given that information. This approach yields insights as to the value of alternative monitoring and research efforts; the uncertainty in sediment sources and effectiveness of controls; and the robustness of alternative sediment control strategies to the uncertainties.

Two applications are summarized: a tutorial to illustrate the methodology, and an application to the Maple River (MN) basin, where sediment is a major impairment. This application is part of a multi-institution effort to better understand sources of sediment in the Minnesota River Basin and assess alternatives for achieving TMDL targets. The model reveals that the value of information depends on the precision of the information obtained from the research actions as well as the effectiveness and cost of BMPs. The applications show how the optimization model can be used to recommend appropriate research actions and restoration efforts as a part of an adaptive management program for reducing water quality impairments in a watershed.

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Integrating Delta Building Physics & Economics: Optimizing the Scale of Engineered Avulsions in the Mississippi River Delta

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Land loss in the Mississippi River Delta caused by subsidence and erosion has resulted in habitat loss, interference with human activities, and increased exposure of New Orleans and other settled areas to storm surge risks. Prior to dam and levee building and oil and gas production in the 20th century, the long term rates of land building roughly balanced land loss through subsidence. Now, however, sediment is being deposited at dramatically lower rates in shallow areas in and adjacent to the Delta, with much of the remaining sediment borne by the Mississippi being lost to the deep areas of the Gulf of Mexico.

A few projects have been built in order to divert sediment from the river to areas where land can be built, and many more are under consideration as part of State of Louisiana and Federal planning processes. Most are small scale, although there have been some proposals for large engineered avulsions that would divert a significant fraction of the remaining available sediment (W. Kim, D. Mohrig, R. Twilley, C. Paola, and G. Parker, "Is It Feasible to Build New Land in the Mississippi River Delta,?" *EOS*, 90(42), 2009, 373-374). However, there is debate over whether small or large diversions are the economically optimally and socially most acceptable size of such land building projects. From an economic point of view, the optimal size involves tradeoffs between scale economies in civil work construction, the relationship between depth of diversion and sediment concentration in river water, effects on navigation, and possible diminishing returns to land building at a single location as the edge of built land progresses into deeper waters. Because land building efforts could potentially involve billions of dollars of investment, it is important to gain as much benefit as possible from those expenditures.

In this talk, we present the result of a general analysis of scale economies and diseconomies in land building from engineered avulsions. The analysis addresses the question: how many projects of what size should be built at what time in order to maximize the amount of land built by a particular time (50 years in the future)? The analysis integrates three models:

1. Coarse sediment diversion as a function of the width, depth, and timing of water diversions (using our field measurements of sediment concentration as a function of depth),
2. Land building as a function of the location and amount of sediment diverted, accounting for bathymetry, subsidence, and other factors (using the model of Kim et al., *ibid.*), and
3. Cost of building and operating the necessary civil works. Our statistical analysis of past diversions indicates existence of strong scale economies in width, but not in depth.

The analysis explores general relationships between size, cost, and land building, and does not consider specific actual project proposals. Sensitivity to assumptions about fine sediment capture, accumulation rates for organic material, and other inputs will be discussed.

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Promoting Science-based Decisions: The Louisiana Coastal Area (LCA) Science and Technology (S&T) Program

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The need to counteract the extensive wetland loss in coastal Louisiana has resulted in the identification of an unprecedented number of scientific uncertainties that must be resolved in order to design, construct, and operate successful coastal and ecosystem restoration projects. The Louisiana Coastal Area Science and Technology (LCA S&T) Office was authorized in WRDA 2007 in order to help address these needs. The Office is a joint effort between the Corps of Engineers and the State of Louisiana's Office of Coastal Protection and Restoration.

The primary objective of the LCA S&T is to develop and provide scientific and technical support to State and Federal coastal restoration project managers. This is done by providing the necessary science and technology to effectively address coastal ecosystem restoration needs, providing analytical tools and recommendations to the Program Management Teams for appropriate studies to reduce uncertainties, integrating the roles and resources of the scientific community and other coastal protection agencies and partners at the state, local, and Federal level, and providing for internal and external technical review and a systematic approach for coordination with other ongoing and planned related research activities. External technical review is led by the LCA Science Board, a group of well-known academic and government scientists from across the United States.

Topics addressed by the LCA S&T are wide-ranging, varying from subsidence and exotic plants to storm surge and adaptive management. Due to the obvious geological and historical linkages between the Mississippi River and Louisiana coastal wetlands, many of the efforts of the S&T Office are centered on hydraulic and sediment transport processes in the river. Research efforts are underway in areas such as the distribution of suspended sediment particle sizes with depth, the total sediment load of the Mississippi River, and the movement of Mississippi River water into adjacent estuaries.

The activities of the LCA Science Board as well as the studies and publications of the LCA S&T Office are made available to other scientists and the public on the S&T website at:
<http://www.mvd.usace.army.mil/lcast/index.html>.

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Masonville Dredged Material Containment Facility: Mitigation Design and Implementation Including Upland Remediation and Community Access

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As a component of the Masonville Dredged Material Containment Facility (DMCF) project, the Maryland Port Administration (MPA) was required to construct several environmental mitigation projects to offset filling about 130 acres of waters of the Patapsco River, which is a major tributary to the Chesapeake Bay. The mitigation is a comprehensive package of inwater and upland projects totaling over \$20 million. The majority of mitigation is located adjacent to the DMCF in the 71 acres of open water and 54 acres of uplands that comprise Masonville Cove. The projects serve to enhance existing habitat and remediate contamination from historical dumping as well as provide opportunities for community-based environmental education to promote stewardship of the Bay waters for the local citizens. The mitigation projects include the creation and enhancement of tidal and nontidal wetlands, reef creation and substrate improvement, upland remediation, terrestrial habitat enhancement and construction of an environmental education center and trails. Implementation of the mitigation package required integration of the remedial activities with the habitat enhancements and coordination with stakeholders and community members. The upland project serves to remediate contamination from historical dumping adjacent to the DMCF and integrate the remedial objectives with the habitat enhancements and provide ecosystem restoration efforts. . The site was thoroughly characterized by collecting and analyzing over 200 surface and subsurface soil samples. A Human Health Risk Assessment was performed to develop Site Specific Clean-up Goals based on the proposed use as a public access park, and the results of the site investigation were compared to the clean up goals to identify areas of proposed remedial action. Remedial options were evaluated through a Corrective Measures Alternatives Analysis which considered the nature of contamination, proposed future use, and federal, state and local Applicable or Relevant and Appropriate Requirements.

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Great Lakes Great Stakes

Gail Krantzberg

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Seen from space, the Great Lakes appear as sparkling jewels strung across the center of North America. The Great Lakes ecosystem is one of the great natural wonders of the world. It is hard to overstate its importance. Nearly one-fifth of the planet's surface fresh water is stored in and flows through the lakes. One out of every three Canadians and one of every ten United States residents takes her or his drinking water from the Great Lakes. The Great Lakes Water Quality Agreement was negotiated pursuant to the 1909 Boundary Waters Treaty between the United States and British Canada that had created the International Joint Commission (IJC) to help resolve problems including pollution that was causing injury to health or property crossing the binational boarder. The IJC and the institutions added to it were based on the principle of bi-nationalism (two countries collaborating on achieving a set of shared goals) rather than bi-lateralism (two countries negotiating with each other in an attempt to balance interests and protect each other's rights).

In April 1972 Canada and the US signed the Great Lakes Water Quality Agreement (GLWQA). This Agreement expresses the commitment of Canada and the United States to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes Basin Ecosystem (United States and Canada 1972). The GLWQA has had substantial influence on the cleanup and restoration of the region. The progress made since 1972 is evidenced by the documentation by scientists in 2005 (first time since 1916), 2006, and 2007 of the presence of spawning lake whitefish and eggs in the Detroit River, the resurgence of cormorant populations, the rediscovery of sturgeon populations, and the return of nesting and fledging bald eagles.

For nearly four decades the Great Lakes regime has had the opportunity to invoke the GLWQA as the mechanism for binational cooperation on programs and policies to enhance and protect the integrity of the Great Lakes and its watershed. Many advances in water quality have lead to unquestionable improvements in ecosystem quality, habitat and biodiversity, and water infrastructure. As reported at the 2009 State of the Lakes Ecosystem Conference "[r]eleases of targeted bioaccumulative toxic chemicals have declined significantly from their peak period in past decades and, for the most part, no longer limit the reproduction of fish, birds and mammals. Concentrations of contaminants in the open waters are low, and many contaminants are further declining".

The GLWQA relies heavily on citizens to ensure compliance and implicitly recognize that the two federal governments may have more in common with each other than with citizens and other stakeholders on both sides of the border when it comes to environmental protection and harm. While acknowledging progress towards meeting the purpose of the GLWQA, Great Lakes scientists have issued compelling evidence that the ecological health of the basin ecosystem is at significant risk and could be approaching a tipping point. According to Bail et al. (2005) "[t]here is widespread agreement that the Great Lakes presently are exhibiting symptoms of extreme stress from a combination of sources that include toxic contaminants, invasive species, nutrient loading, shoreline and upland land use changes, and hydrologic modifications. Many of these sources of stress and others have been impacting the lakes for over a century. These adverse impacts have appeared gradually over time, often in nearshore areas, in the shallower portions of the system, and in specific fish populations. Factors such as the size of the lakes, the time delay between the introduction of stress and subsequent impacts, the temporary recovery of some portions of the ecosystem, and failure to understand the ecosystem-level disruptions caused by the combination of multiple stresses have led to the false assumption that the Great Lakes ecosystem is healthy and resilient."

This presentation will uncover a governance deficit in the Great lakes regime, and a watershed moment to address that deficit through the renegotiation of the binational Agreement.

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Effective Partnering to Advance Integrated River Basin Management

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The Nature Conservancy (TNC) and the U.S. Army Corps of Engineers (Corps) have been effectively partnering on ecosystem restoration and integrated watershed approaches to dam management domestically for over 10 years. Building on this successful partnership, the Corps has provided technical assistance to TNC and foreign governments on aquatic ecosystem challenges. This partnership demonstrates to foreign agencies the ability of a governmental organization and a non-governmental organization to work collaboratively. TNC's Great Rivers Partnership (GRP) brings together a diverse set of stakeholders and partners, including the Corps, to contribute to the conservation and sustainable development of the world's great rivers. The GRP aims to advance integrated river basin management (IRBM) with its initial focus on the Mississippi River and the Yangtze River in China.

The GRP was formally established in 2005 with a grant from the Caterpillar Foundation. The GRP is acknowledged for: 1) calling attention to the plight of the world's greatest rivers; 2) leveraging Mississippi River best practices as a global case study; 3) promoting and demonstrating a systems approach to river management; and 4) engaging diverse partners. The Corps is in the process of becoming a formal partner of the GRP and will compliment TNC's efforts to advance IRBM. GRP follows the globally accepted definition of IRBM as "the process of coordinating conservation, management and development of water, land and related resources across sectors within a given basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems."

TNC and the Corps are working to meet stakeholder needs in improving management of the Magdalena River in Colombia. The Magdalena River is the most significant river in this country of 44 million people. Over 80% of the population lives within the basin which is economically critical for the country. The Magdalena River basin spans 274,000 km² and embraces almost every Andean ecosystem, from snow-capped mountains, high-altitude grasslands and countless wetland to cloud forests, dry forest valleys and coastal lagoons. This variety of habitats and the still unchanged natural flow regime makes the watershed one of the most biologically diverse areas in the world and the river one of the few of this size with similar natural characteristics.

The Magdalena River is one of the most vulnerable places to climate change. The economic and human losses on the last decade due to the "Niña" and "Niño" southern oscillation have attracted the attention of Colombians. The economic losses in 2010 are calculated in 2% of the GDP of the country. The watershed needs an urgent integral management of its natural resources. TNC and the Corps have been partnering to provide technical assistance to CORMAGDALENA, the governmental agency that has oversight of the river, including navigation, dredging, floodplain management, levee development and ecosystem restoration, including environmental flows.

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Importance of freshwater inflow for natural resources of the lower Delaware River Basin and Estuary

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The maintenance of water balance, especially freshwater inflows, is especially important in watersheds such as the Delaware Estuary which has one of the world's largest freshwater tidal prisms. From Trenton, New Jersey, to Wilmington, Delaware, the system contains a rich and rare assemblage of wetland and aquatic species uniquely adapted to freshwater tidal conditions, such as wild rice, sturgeon, and rare unionid mussels. Upstream, the Delaware is the longest undammed river east of the Mississippi, and numerous aquatic species such as mussels depend on threshold base flows. Lower in the estuary, a broad salinity gradient is home to important living resources such as oysters, which are vulnerable to diseases that are more virulent and prevalent at slightly higher salinities.

While the system is fairly resilient (and may depend somewhat) on punctuated disturbances brought by high flows (e.g. sediments supplied to tidal wetlands during floods), its natural resources appear to be especially vulnerable to low flows (e.g. high salinity during droughts.) The maintenance of base flow in the Delaware River is critical since it supplies approximately 60% of the total freshwater to the tidal estuary, and it also provides drinking water for more than 15 million people (even though only 9 million live in the watershed.) Managers face increasing pressure to allocate more water for various consumptive uses, such as water for New York City and natural gas drilling.

Meanwhile, increasing sea levels will bring more saltwater into the estuary and amplify tidal ranges and volumes, which could be further modified by channel deepening. Increased precipitation is projected to occur, but this will mainly happen in pulses in winter. Decreased snowpack will lead to lower seasonal holding capacity. Taken together, climate change combined with changes in water management and system configuration will likely alter the balance of freshwater and saltwater in the upper and middle estuary regions.

Without careful maintenance of base flow, important natural resources will be increasingly threatened, such as freshwater mussels, freshwater tidal plants, oysters and possibly fish assemblages, as well as drinking water for Philadelphia which draws water from the freshwater tidal reach. Both restoration planners and flow managers must understand the complex interactions that will affect water balance in the future and plan accordingly across four states and various federal management boundaries that often represent barriers to cooperation.

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Re-Creation of Ecotone Transitions in South Florida from Theoretical Model Distributions and Sea-Level Rise Curves

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Ecotone transitions are one of the signature measurements of change in an ecosystem because they show a clear boundary to measure competing environmental factors. South Florida is uniquely situated for measuring ecotone transitions related to salinity and sea level rise (SLR); the area is susceptible to small fluctuations in the marine/freshwater interface and is near the site of a key historical instrumentation: the tidal-gauge record at Key West, FL.

Research on the ecotone transition from mangrove to hardwood hammock is being done with MANHAM, a spatially explicit model of two competing vegetation types. A consequence of the model is that short-lived marine inundations may result in a change to the equilibrium boundary that can lag the event by 20 years. A way to verify this model prediction is to run a hindcast of historical conditions from an inundation event that would manifest itself in the two-decade timeline required by the model.

Recent work by Obeysekera et al. (2010) has proposed that the tidal-gauge record at Key West can be processed to emphasize discrete events rather than overall trends. Thirteen possible candidate events have been proposed, most of which correspond to historic hurricanes. The largest event occurred in 2005 and corresponds to Hurricane Wilma, whose track was located greater than 100 km west of Key West.

The second largest event corresponds to a storm on October 18 – 20th, 1944. The storm track was also greater than 100 km from Key West. Recent compilation of historical hurricane data from NOAA's Re-Analysis Project shows the 1944 storm was similar to Wilma in size, track, and area of impact. The eye was estimated to be 65 – 100 km wide and tidal records indicate surge heights of 2.5 m and 3.7 m above mean low water at Key West and Naples, FL, respectively.

The 1944 event is being used as a historical input into the MANHAM model to run multiple forward models. These results may indicate likely areas of past ecotone transitions that can be verified by current distributions and provide a means to verify and improve the model. Historical aerial photographs from the 1960s and 1970s will be used to delineate the position of the ecotone boundary approximately 20 years after the event. This deduction of present vegetation distribution from models of historic conditions is a controlled way to provide better understanding of the ecotone-boundary dynamics.

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The Intersection of Science and Decision Making in the Glen Canyon Dam Adaptive Management Program

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Passage of the Colorado River Storage Project Act in 1956, which laid the legislative foundation for construction of Glen Canyon Dam, was met with little fanfare. The U.S. was moving forward quickly in the post-war development period, environmental laws that would force closer evaluation of large federal projects had not been enacted, the Colorado River Basin states were sparsely populated and represented in Congress by development interests, and the semiarid region largely was reliant on an agrarian economy dependent on irrigation. The first rumblings of discontent over the operation of the dam occurred in the early 1970s when commercial river runners sought legal status to force reduction of the large daily fluctuations in dam releases for hydropower production. By the early 1980s, acrimony had risen to a sufficiently high level that the Bureau of Reclamation agreed to fund a comprehensive evaluation. In 1989 the Secretary of the Interior (Secretary) directed the development of an environmental impact statement. Completion of the National Environmental Policy Act evaluation was stimulated by passage of the 1992 Grand Canyon Protection Act. An outcome of the environmental impact statement was the formation of the Glen Canyon Dam Adaptive Management Program (GCDAMP) in 1997 as a vehicle for scientific investigation and development of recommendations to the Secretary.

A consistent commitment to science through adaptive management in the GCDAMP was ensured by a requirement for monitoring and research in the Grand Canyon Protection Act and in the Record of Decision on operation of the dam. This function is carried out by the U.S. Geological Survey through the Grand Canyon Monitoring and Research Center (GCMRC). Further input to the science process is provided by a standing body of science advisors and by ad hoc groups of scientists who periodically review the protocols for research and monitoring. GCMRC reports its findings to managers and other stakeholders through a Technical Work Group and subsequently to a federal advisory committee, the Adaptive Management Work Group (AMWG). The AMWG then makes recommendations to the Secretary, the ultimate decision maker, through a Secretary's Designee, who also chairs the committee.

Most high-level decisions made in the GCDAMP are responses from the Secretary to recommendations by the AMWG, which operates by consensus when possible and otherwise through a supermajority vote. Two decision-making processes have been used in the GCDAMP: Multi-Attribute Tradeoff Analysis and Structured Decision Making, but no commitment has thus far been made to a consistently applied process.

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Challenges of Barrier Shoreline Restoration in Coastal Louisiana

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Louisiana contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal marsh loss occurring in the Nation. Both natural and manmade actions are causing adverse impacts on the Louisiana coast. Construction of levees along the Mississippi River has cut the coastal ecosystem off from a primary source of sediment and nutrients, and hindered the wetlands' ability to maintain their elevation in the face of sea level change and subsidence. The shorelines are starved for sediment and are retreating. The barrier shorelines in Louisiana separate the Gulf of Mexico from the interior estuaries, helping to regulate salinity gradients important to estuarine and freshwater wetland species and preventing marine wave energy from eroding interior marshes.

The Barataria Basin Barrier Shoreline Restoration project and the Terrebonne Basin Barrier Shoreline Restoration project were contingently authorized by Title VII of the Water Resources Act of 2007. Planning studies conducted by the Corps of Engineers and the State of Louisiana emphasized the restoration and maintenance of the form and function of 38 miles of the barrier shorelines. Louisiana barrier shorelines consist of three landforms: beaches, dunes, and marsh. Consequently, shoreline restoration is necessary in conjunction with marsh restoration for optimal shoreline protection and ecosystem restoration. Lack of available sediment as well as the high cost of transporting that sediment are major challenges for the restoration projects. The Mississippi River and shoals from one of the older abandoned Mississippi River deltas are the only sources of the well-graded quartz sand needed to restore beaches and dunes. Ship Shoal, the nearest accessible sand source for much of the Barataria and Terrebonne basins, is 40 miles from the Caminada Headland in the Barataria Basin. An estimated 100 million cubic yards of material is required to construct and maintain these barrier shoreline projects.

Planning and designing barrier shoreline restoration projects are complicated by the dynamic nature of the coastline. The episodic nature of the coastal land mass changes is reflective of sharp decreases in land area caused by a tropical event followed by a period of healing as some of the materials washed away by the storm are returned to the land mass. The dynamic nature of the shorelines makes it more difficult to accurately simulate and predict the affects of restoration plans. The Louisiana coast is a "working coast." Pipeline canals, oil and gas infrastructure, private property land rights, and recreational use of the coastal wetlands impact coastal restoration. Despite these challenges, barrier shoreline restoration is a critical component of Louisiana coastal restoration.

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An Update on USACE Guidance for Ecosystem Restoration Projects Subject to Impact by Future Sea Level Change

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The U.S. Army Corps of Engineers (USACE) issued guidance in July 2009 requiring all Civil Works projects in the Planning, Engineering Design, Construction, or Operations and Maintenance phases to consider potential impacts from future sea level change. This guidance, Engineering Circular (EC) 1165-2-211, provides detailed information on how to calculate forecast low (historic), intermediate and high rates of sea level change, but provided very limited guidance on subsequent planning and decision making steps required to implement this EC. This presentation will provide current information on additional guidance now being developed, with particular attention to sections relevant for ecosystem restoration projects subject to impact by future sea level change. Examples will be given of different coastal environments around the United States and the range of potential ecosystem impacts which may need to be addressed in evaluating alternative adaptation strategies.

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Deep Creek Lake: Finding the Balance between Recreational Use and Ecological Health

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Deep Creek Lake (DCL) is a unique ecosystem located in Garrett County, Maryland. The 3,900 acre lake was formed in 1952 when Deep Creek was impounded as source water for hydroelectric power generation. Today, the lake is still used for hydroelectric power and the 65 miles of shoreline are developed to near capacity with seasonal and permanent residential homes, condominiums, and commercial areas. Vacationers flock to the lake every summer to take advantage of the numerous recreational activities the lake has to offer, including water skiing, boating, fishing, and swimming. Tourism from lake related activities has become a vital component to the local economy.

In 2000, General Public Utility sold the lake bottom and shoreline buffer to the State of Maryland, to be managed as public lands by the Department of Natural Resources (DNR). This acquisition has presented many unique and challenging management issues to DNR's Park Service because while the lake and buffer strip are publicly owned, the land surrounding the lake is private.

Responding to complaints by DCL stakeholder groups of excessive submerged aquatic vegetation (SAV) in some areas, DNR's Resource Assessment Service initiated a study of the lake's SAV composition, density, and distribution. This study is only one part of a much larger DCL Water Quality Monitoring Program. Although only one season of SAV surveying has been completed, initial results indicate that SAV is diverse and abundant throughout the lake, contributing positively to the overall health of the lake, and is serving as habitat for a large population of fish. Unfortunately, as the complaints indicated, SAV grows to the surface during the later summer months in some of the smaller coves where the water is quite shallow, and becomes a nuisance for waterfront homeowners and vacationers that want to swim or boat near their property.

State Goals for DCL are to protect the lake as a natural resource, preserve its ecological balance, and further its use as a recreational resource (Code of Maryland Regulations 08.08.01.01). From the landowner's and boater's perspective, the latter goal of furthering the lake's use as a recreational resource is the most important, and SAV should be removed from the lake. From the fisherman's perspective, protecting the lake as a natural resource, and consequently the SAV as fish habitat, is the most important goal. The dichotomy of viewpoints with respect to the presence of SAV in Deep Creek Lake has presented many challenges to the management of the lake itself. To create partnerships between the stakeholder groups in which a balance between ecological and recreational value is established is vital to the successful management of the lake.

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Everglades Restoration, Swamped by Invasive Species

Jon Lane

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The primary goal of the Comprehensive Everglades Restoration Plan (CERP) is to restore more natural hydrologic conditions to the wetlands and estuaries of South Florida. This change in hydrologic conditions is giving some invasive plant species an advantage over the native species we are trying to restore. Not only are we seeing an expansion of established invasive plant species like Brazilian Pepper and Water Hyacinth but we are seeing numerous new invasions from plants such as *Luziola subintegra*.

In addition to these plant invasions, we are seeing an alarming increase in new invasive animals since the inception of CERP in 1999. These include Burmese and Rock Pythons, Tegus lizards, Purple Swamp hens and Sacred Ibis. If not managed, these species could prevent CERP from achieving its restoration goals and performance measures. New evidence is also showing a startling increase in new invasive fish species in Everglades National Park, which may be a result of projects, intended to restore hydrologic conditions. These invasive fishes could have enormous negative consequences on the future Everglades aquatic ecosystem.

This presentation will explore numerous invasive species and their real and potential impacts on Everglades restoration and examine the issues and roles of invasive species management in ecosystem restoration projects.

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Role of a USGS Hydrologic Monitoring Network in a Landscape-scale Experiment to Reconnect Flow in the Everglades

*Morgan Maglio, Katie Skalak, **Trevor Langston**, Jay Choi, Laurel Larsen and Jud Harvey*

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Flow velocities and hydraulic retention times are critical drivers in sediment transport, nutrient cycling, and function of aquatic ecosystems. Quantifying flow and its ecological impacts in channels and wetlands is therefore a critical research direction for USGS. One focus of the \$10.9 billion congressionally authorized Everglades restoration is restoring the quantity, quality, timing, and distribution of water deliveries by removing existing hydrologic barriers (i.e. levees and canals). The Decartmentalization Physical Model (DPM) was designed by a partnership of federal and state agencies and universities with the aim to assess the effectiveness of flow restoration and canal backfilling. DPM utilizes temporary controllable culverts in an upstream levee and a 3,000 foot gap in a downstream canal-levee feature, which will elevate velocities by an order of magnitude (to greater than 3 cm/s). Elevated velocities will entrain and redistribute fine sediment and associated particulate phosphorus between different plant communities, which is hypothesized to be important in maintaining biodiversity and landscape pattern. The USGS installed an extensive hydrologic monitoring network in the DPM study area, which consists of 20 stations outfitted with acoustic Doppler instrumentation, pressure transducers, particle size analyzers (LISSTs), and staff gauges. This network is used to characterize flow before, during, and after planned pulsed-flow releases within and outside the affected footprint. Pre-release characterization shows ambient flow velocities that are consistent with the reported average (< 1 cm/s). Our results also indicate that flow magnitude and direction are highly variable temporally and spatially, reflecting the effects of wind, water management operations, and dynamic vegetation communities.

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Nine Mile Creek - Urban Watershed and Stream Restoration Planning and Implementation

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In 1959, Nine Mile Creek Watershed District was the first urban watershed district formed in Minnesota. The District encompasses about 50 square miles in southern Hennepin County, within the Twin Cities Metropolitan Area. The headwaters of Nine Mile Creek are in the City of Hopkins and Minnetonka, with the creek flowing fifteen miles through a fully urbanized watershed before entering the Minnesota River nine miles upstream of the Mississippi River confluence. Nine Mile Creek experiences many water quality problems characteristic of urban streams. These problems arise due to the increased quantity and degraded quality of runoff reaching the creek from a 25,500 acre watershed that has 42% impervious surface.

In 2003, the entire creek system was surveyed, classified and rated for sensitivity to disturbance, recovery potential, and existing condition. Results of the physical classification were used in combination with biological and water quality survey information to perform Ecological Use Classification (EUC) assessments of Nine Mile Creek stream reaches. The assessments indicated biological impairments were related to habitat degradation caused by the scouring effects of the increased frequency of bankfull or greater flows in the creek.

The City of Bloomington petitioned the District following an extreme storm event in 1987 to address severe bank erosion within the "Lower Valley" of the creek, where the creek descends to the Minnesota River Valley. The District completed an erosion assessment of the Lower Valley and working with Barr Engineering, in conjunction with University of Minnesota researchers, implemented the first stream and corridor restoration project in 1991. This project included stabilization and revegetation of the high valley walls, relocation of portions of the stream, installation of porous deflector dikes, construction of rock grade controls, and importation of graded gravel material. More recently, the upstream communities of Hopkins and Edina have subsequently petitioned the District for implementation of stream corridor restoration as well. Stream restoration was initiated in Hopkins in 2010 and will continue into 2012; construction of the Hopkins to Minnetonka reach will begin in 2011, and design of the Edina reach will begin in 2011.

Project outcomes were measured using fish and benthic macroinvertebrate metrics, and water quality monitoring. Ecological benefits as a result of the changes in stream condition, especially the biotic community (biotic integrity indices) have been negligible. Water quality trend analysis does indicate an improvement in water quality and decreases in pollutant loads since 1993, when the Lower Valley Project was completed.

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Valley Creek Watershed and Stream Restoration

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Valley Creek, located in the city of Afton, Minnesota, is widely considered to be one of the finest trout streams in the Twin Cities area. The stream is largely groundwater fed and still has a relatively undeveloped watershed. The trout population is composed of primarily brook and brown trout, with limited numbers of rainbow and tiger trout. Valley Branch Watershed District completed a Valley Creek Erosion Inventory in 2005, which is a continuation of the study process that began with the 1999 Valley Creek Natural Resources Inventory (NRI). The NRI identified and characterized natural resource features, including plant communities, soils, stream characteristics and drainage patterns. It also provided a severity ranking for erosion from streambanks and ravines. The inventory investigated and documented approximately 90 erosion sites in seven tributary ravines, more than sixty streambank erosion sites, and approximately 33 sites adjacent to roadway runoff areas that have potential to contribute sediment to Valley Creek.

The District completed projects in 2008 that reconnected more than 2,200 feet of the creek to its floodplain, corrected three large bank erosion sites, and provided for runoff infiltration. The projects served to improve trout habitat and reduce sediment inputs to the St. Croix River. A permanent easement was obtained from a private landowner for the infiltration basin and temporary easements were obtained for the stream reaches. Five private properties were included in the project area. All of the reaches had poor-quality vegetation and badly incised channels in the sandy soils. The selected stabilization option for the longest reach raised the channel profile and created a new, lower floodplain to increase the frequency of overbank flooding, thereby reducing stress on the channel banks. Hydraulic modeling ensured that the channel dimensions and materials were properly sized to resist bankfull flow velocities, while not increasing 100-year flood levels.

Concurrent with the 2008 construction, the Minnesota Department of Natural Resources collaborated with Washington County to provide trout habitat at the reconstructed CSAH 18 Bridge crossing, a short distance upstream of the St. Croix River and downstream of the above-mentioned stabilization projects. In 2010, the District replaced a privately-owned dam near the headwaters of Valley Creek with a series of rapids, eliminating a barrier to fish passage and improving sediment transport. Currently, the District is working with another private property owner to design restoration measures on approximately 8,200 feet of badly incised creek channel.

Invertebrate and fish community data, and water chemistry data were collected pre- and post-project to assess the impact of the stream channel improvements. The monitoring data has shown brook trout have returned to some reaches; additional data will be presented to evaluate the project effectiveness over the short-term.

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Integrated Planning for Ecological Restoration and a City's Increasing Water Resource Demands

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The City of Franklin, Tennessee is a growing city relying on a small river to meet water demands. As the City continues to grow, the stresses placed on that water resource continue to compound; and, when weather extremes occur, the stresses are intensified. Protecting the Harpeth River's ecology and value as a recreational resource is not only required from a regulatory standpoint but is desired as part of the quality of life in Franklin. At the same time, the City needs a reliable long-term source and infrastructure for drinking water and irrigation and sustainable solutions and infrastructure for reclaiming wastewater and discharging treated effluent when reclaimed water use is not feasible. With these challenges, the City looked to develop a long range plan that establishes governing science and engineering principles, evaluates and debates alternatives, and builds broad consensus around a comprehensive set of sustainable, affordable actions that will provide for effective management of the City's water resources.

In 2009 Franklin initiated the first of two phases of an integrated water resources plan (IWRP) – a stakeholder-driven process aiming to reevaluate and plan for their water resources needs from a long-term, holistic perspective. The purpose of Phase I was to convene a diverse stakeholder advisory group and formulate a list of objectives that the IWRP shall address. The stakeholder group consisted of regulatory agency representatives, watershed associations, utility directors, Franklin residents, and technical experts. A preliminary evaluation of potential water, wastewater, stormwater, and reclaimed water projects to be included in the final IWRP was performed using an integrated systems simulation model and performance measures derived by the stakeholder groups. The performance measures by which the various project options were evaluated included a wide variety of metrics, including each action's potential effect on the Harpeth River water quality and ecology. The outcome of Phase I was a greater understanding of Franklin's water resources systems, how management decisions may affect the Harpeth River ecology, consensus amongst stakeholders on the objectives of the IWRP, and a refined list of project options to be studied further in Phase II. The purpose of Phase II (currently underway) is to perform more in-depth analyses of the cost and benefit of the project options identified in Phase I. A dynamic river simulation model, detailed engineering studies, and conceptual designs will provide refined estimates of the performance of project options over the 30 year planning period.

This presentation will focus on the stakeholder-driven process that allows ecosystem restoration to receive equal consideration alongside wastewater and water supply demands as a City plans for future water management and infrastructure needs. The integrated system simulation model enables stakeholders and decision-makers to clearly see how the effects of water management decisions extend throughout all aspects of the City's water resources system.

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Management Options for Phosphorus Load Reduction to the Assabet River Amid Regulatory and Stakeholder Challenges

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Phosphorus concentrations in the Assabet River, located approximately 20 miles west of Boston, Massachusetts, are causing excessive production of floating and rooted aquatic macrophytes. The phosphorus loadings originate from both non-point sources and point sources - including wastewater treatment plants and stormwater runoff. The presence of excess nutrients within the Assabet River system is compounded by the presence of a series of impoundments along the river, resulting in eutrophication and impairing designated uses as defined by State Water Quality Standards including recreation, aesthetics, and fish and wildlife habitat.

In 2004 the Massachusetts Department of Environmental Protection (MassDEP) issued a Total Maximum Daily Load (TMDL) for the Assabet River, requiring implementation of measures to decrease phosphorus loading to the river in two phases. Phase 1 requires reductions in wastewater treatment facility discharge phosphorus concentrations; Phase 2 requires that additional projects be implemented to reduce total phosphorus loading to the river. In 2010, the US Army Corps of Engineers New England District (USACE) completed a study of various options to achieve the targeted phosphorus reductions, focusing on the following restoration goals and objectives: 1) improved water quality to meet State Water Quality Standards, and 2) achievement of a sustainable and improved aquatic ecosystem. The following options were explored: sediment dredging alone; sediment deactivation; planned wastewater treatment facility improvements; dam removal; reductions in sediment phosphorus flux; adaptive management approach; and seasonal wastewater discharge limits.

While the phosphorus reduction strategies highlighted by the USACE study would likely improve the ecological conditions in the Assabet River, other stakeholders involved in the restoration oppose the removal of dams and have expressed concerns regarding the removal of sediment. During public meetings and through public comment on the draft study results, USACE and MassDEP learned that many in the local communities value the existing impoundments for recreation, aesthetics, wetlands, fish and wildlife communities, historic and cultural significance, and as a water source for fire protection and irrigation. Community stakeholders are also concerned about the public health risk related to exposing sediments and the potential negative economic impacts of removing the dams and sediment.

The USACE study provides a basis for communication between regulators and stakeholders on how to best manage the restoration of the Assabet River. Communities around the nation are facing the same challenge: How to garner support and leverage resources from local stakeholders to achieve regulatory compliance. There is rarely a single, implementable solution, and adaptive management of these issues often becomes the best path forward.

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Connecting Water Quality to Infrastructure Protection: A Case Study of Urban Stream Stabilization

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Over recent years several studies and well documented reports have noted that excessive sediment and nutrient loads from urban streams are adversely affecting the aquatic habitat in the Chesapeake Bay. Baltimore City contains 5 major watersheds and is home to over 200 miles of urban stream channel, with many of the streams exhibiting some level of water quality impairment that contribute to the Chesapeake Bay. Common water quality impairments exhibited in City streams include excess nutrient loadings, excess sediment loadings, toxics, high/low pH levels, high water temperature, biological contamination, and trash impairments.

As a condition of the Baltimore City NPDES permit, the City is required to investigate and address the pollution of streams and to improve the water quality of its streams and the bay. To this end, the Baltimore City Department of Public Works - Surface Water Management Division (DPW) has conducted numerous studies to identify opportunities to install Best Management Practices (BMP), assess stream stability, estimate sediment and nutrient load to the Chesapeake Bay, and improve stream corridor habitat conditions. The DPW is conducting water quality improvement projects Citywide that will help accomplish the goals of the Clean Water Act by improving the water quality of City Streams and the Chesapeake Bay, and enhancing the riparian areas around the free flowing portion of the stream. One of the recently completed efforts is the Western Run Stream Stabilization project.

Among the many urban streams in the City, Western Run has been identified as a source of unwanted sediment and nutrient pollution. In addition to the water quality impacts, stream bank erosion along the Western Run was threatening public infrastructure and private properties. The City DPW, working with Parsons Brinckerhoff (PB), developed a stream stabilization design for a segment of Western Run to address stream instabilities in Western Run and mitigate the direct sediment and nutrient loadings to the stream flows from channel bank erosion.

This presentation will highlight the objectives of the project which include improving in-stream habitat, protection of public infrastructure, protection of public and private property, and reduction the unwanted sediment and nutrient supply caused by erosion of the channel banks. The project involves a stabilization design that utilizes natural materials and bioengineering practices to protect the stream banks and provide riparian habitat. The establishment of vegetation along stream banks is important to natural stream functions as it provides a number of aquatic and terrestrial benefits. These benefits include root-mass that stabilizes the stream banks, shading to manage increases in stream temperatures, food and shelter for wildlife, wildlife travel corridors, and overland flow resistance to reduce stream erosion potential, enhance infiltration of urban surface water runoff and minimizes the uptake of nutrients from the soil.

Construction of the project was substantially completed in the winter of 2010. While Western Run in the near term will continue to have other forms of water quality impairments from the urbanized watershed, completion of the stream corridor stabilization project provides a solid foundation towards the larger water quality and ecosystem restoration goals.

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Trash Talk: Cleaning up the Waters in Baltimore City and the Watershed 263 Trash Collection Program

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Floatable trash and debris littering the aquatic resources of Baltimore City have become a pervasive problem of recent times. The presence of this litter is impairing the regions' aquatic habitat, creating an eyesore to community harbor promenades and trailways, providing a source of pollution to the Chesapeake Bay and generally degrading the quality of one of Baltimore City's great assets, the Inner Harbor.

The City of Baltimore, Department of Public Works through the efforts of the Surface Water Management Section has begun an aggressive debris interception and collection program to address this problem. The City's program intends to use both in-line and off-line debris collection devices to directly address the problem. The City is also involving communities and providing education to proactively address the root of the debris problem, littering of neighborhood streets.

This presentation will discuss the Watershed 263 project under development by Parsons Brinckerhoff (PB) and Baltimore City's stormwater borne trash collection efforts. Watershed 263 is a 1.45 square mile watershed situated in western Baltimore City and is primarily composed of older dense residential row homes. Watershed 263 contains twelve city neighborhoods including Harlem Park and Sandtown at its headwaters, Carroll Ridge and Franklin Square in the central portion and the Carroll-Camden Industrial Area near the outfall to the Middle Branch. The watershed is a large source of many different water quality pollutants and has contributed to 303(d) listings for nutrients, toxics, biological, metals, sediment, and trash for the receiving waters. During the presentation PB will discuss efforts in quantifying the pollutant contributions from the watershed, the direct and ancillary benefits on water quality from the trash collection program, and the various designs under consideration for treatment of the watershed.

The presentation will conclude with a discussion of past trash interception projects implemented by the City DPW. These systems include vault based net collection systems, floating net systems in the harbors, a combination open net / stilling basin system, and the Trash Mill system. Each of these collection systems has had various successes and failures during their operational deployment. Discussions will draw from the City's experiences with these four systems and focus on lessons learned that have aided in the selection and design of the watershed 263 treatment system.

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Management Strategies for Water Chestnut (*Trapa natans*): A historical perspective.

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Water chestnut (*Trapa natans*) is an aquatic plant native to Asia. Introduced to North America near Concord, Massachusetts in 1859, water chestnut became established in locations throughout the northeast and by the early 20th century was moving southward. Water chestnut first appeared in Maryland in the Potomac River near Washington, D.C. as a two-acre patch in 1923. The plant spread rapidly, covering 40 river miles within a few years. By 1933, 10,000 acres of dense beds extended from Washington, D.C. to just south of Quantico, VA. Water chestnut was recorded in the Bird River in Chesapeake Bay for the first time in 1955. The Maryland Departments of Natural Resources (MD-DNR) used mechanical removal and an herbicide (2,4-D) to control the population. This effort was believed to have been successful, and no plants had been detected in vegetation surveys until summer 1997.

Water chestnut was discovered on the Bird and the Sassafras Rivers during the summer of 1997. The population in the Bird River had spread from approximately 50 plants in the summer of 1997 to over three acres in 1998. By this time, the three acre area was so heavily covered with plants that the water beneath the plants was barely visible. Even though plant control experts from around the country advised that 2,4-D would be a safe and effective control technique, MD-DNR opted for manual removal. A massive mechanical and volunteer harvesting effort began on both rivers in 1999. Working from small vessels, canoes, and kayaks, approximately 100 volunteers worked for two weeks to remove 400,000 pounds of plants from the two rivers. Less than 1000 pounds of plants were removed from both rivers in 2000 with a much smaller work force, indicating that the 1999 removal efforts were successful in controlling the outbreak. In 2001, a large volunteer force was used instead of the mechanical harvesters, which was a significant milestone for the overall eradication effort. Since 2001, the harvest effort decreased as the plant abundance declined.

In 2010, after a record low harvest in 2009, biologists discovered large concentrations of plants interspersed with American Lotus (*Nelumbo lutea*) on the Sassafras River. Large numbers of plants were discovered in remote areas, and given that the water chestnut seeds remain viable for years, it is likely to return for the next few years in these locations. The 2011 harvest efforts will focus mainly on harvesting from canoes and kayaks to remove the water chestnut among the lotus.

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Adaptive Management and Ecosystem Modeling: Approach and Application to Everglades

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The goal of an integrated ecosystem modeling and adaptive management (EMAM) framework is to provide restoration plans tools that address risk and uncertainty by using quantifications of ecosystem processes. We will summarize our current projects on: (1) developing a decision-analysis tool for ecosystem restoration projects and programs to support development/implementation of integrated adaptive management plans; and, (2) organization of assessed monitoring data to support decision-making. To illustrate the application of the integrated tools, two case studies are presented: a small scale project (Quincy Marsh, Quincy, MA) and a large scale project (Everglades, FL). Both studies are developed in close collaboration with their respective USACE Districts and utilize actual site data. The Quincy Marsh case study will be presented in parallel talk by Dr. Foran. The focus of our Everglades example is on the cattail/sawgrass vegetation dynamics, threatened and endangered wading birds, and their interactions. Ecosystem processes are modeled with physical-based stochastic or deterministic models and tested against real data. The case studies will generalize the EMAM for application to other USACE ecosystem restoration programs.

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Anthropogenic Renourishment Feedback on Shorebirds: a Multispecies Bayesian Perspective for Beach Restoration in the Face of Climate Change

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The realized niche of the Snowy Plover (*Charadrius alexandrinus*), a residential Florida shorebird, is described as a function of the scenopoetic and bionomic variables at the nest-, landscape-, and regional-scale. We identified some possible geomorphological controls that influence nest-site selection and survival likelihood using data collected along the entire suitable habitat of the Florida Gulf coast. In particular we focused on the effect of beach replenishment interventions on the Snowy Plover (SP), and on the migratory Piping Plover (PP) (*Charadrius melodus*) and Red Knot (RK) (*Calidris canutus*) for comparison. Additionally we investigated the potential differences between the SP breeding and wintering distributions using only regional-scale physiognomic variables and the recorded occurrences. To quantify the relationship between past replenishment projects and the shorebird species we used a Monte Carlo procedure to sample from the posterior distribution of the binomial probabilities that a region is not a nesting or a wintering ground conditional on the occurrence of a beach replenishment intervention the same and the previous year. The results indicate that it was 2.3, 3.1, and 0.8 times more likely that a region was not a wintering ground following a year with a replenishment intervention for the SP, PP and RK respectively. For the SP it was 2.5. times more likely that a region was not a breeding ground after a renourishment event. Through a maximum entropy principle model we observed small differences in the habitat use of the SP during the breeding and the wintering season. However the habitat use for the RK appeared quite different. While ecological niche models at the macro-scale are useful to determine habitat suitability ranges, the characterization of the species' local niche is fundamentally important for adopting concrete multispecies management scenarios. Maintaining and creating optimal suitable habitats for SP characterized by sparse low vegetation in the foredunes areas, and uneven/low-slope beach surfaces, is the proposed conservation scenario to convert anthropic beach restorations and SP populations into a positive feedback without impacting other threatened shorebird species. A correct restoration of the beach habitat impacted by sea-level rise due to climate change is of fundamental importance for the conservation of threatened and endangered species such as shorebirds.

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Decision Analysis and Ecosystem Restoration: Framework and Application Case Studies

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Decision-analysis methods and tools can be used to support ecological restoration planning, including fusion of heterogeneous information to quantify benefits, development of adaptive management (AM) strategies, and identification of an appropriate monitoring plan. This presentation will introduce a strategic approach for using decision-analytical tools in ecosystem restoration projects and will illustrate its application. A decision model provides managers with a framework for understanding how management plans should change based on a given state of information. Such a framework also helps anticipate how different monitoring results could impact the plan. Scenario analysis helps inform whether monitoring can add value to the decision (whether adaptive management is relevant and worthwhile) and, if so, perform basic calculations to eliminate poorly performing management plans and monitoring alternatives. The value of additional studies can be assessed by trading off the improvement in the knowledge of the likelihood of future scenarios and the benefits in terms of better adjustment of the decision and future costs of monitoring. Application of these tools will be discussed in the context of the Quincy Marsh (QM) restoration project in Boston. QM was designed with the objectives of functionality as a buffer for storms, restoration of marshland habitat, and increased recreational opportunities. The design of the restoration included the use of models to determine the design parameters with inputs of probable hurricane parameters, 100-year tides and the stability of wetland habitats. Development of the Adaptive Management plan provides an opportunity for stakeholders to effectively monitor and manage their new marsh project while utilizing the expertise of the designers, engineers and the District and adjusting for possible Climate Change impacts.

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The Use of Biological Indicators to Assess Water Quality in South Africa: Analysis of Case Studies, Methods, and Tools

Mbofho Stanley Liphadzi

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South Africa, like most other developing country, has experienced a profound environmental water quality decline. The poor water quality in water resources has reduced essential aquatic ecosystem services that the majority of rural communities depend on, such as safe drinking water and fish. Poor water quality exacerbates poverty and reduces quality of life, especially in rural areas where there is no water and proper sanitation services. Several studies conducted and applied have shown that there are unique biological indicators (indices) that are easy and less costly to use in monitoring the quality of water resources. The approaches we developed through long-term studies and testing have shown that indigenous indices can be effectively used even by non-scientific communities in taking care of their water resources. Over the last 10 yr, the Water Research Commission with its stakeholders has developed South African Scoring System (SASS) which involves using the aquatic invertebrates to support a national River Health Programme (RHP), and thus national monitoring programmes of water resources. In addition, the diatom index as a water quality monitoring tool has been introduced to strengthen the monitoring programmes. There are studies that are currently underway to explore the use of genetic diversity in monitoring water resources. Communities and learners have participated in using SASS to collect data relating to the health integrity of the rivers in their areas. This presentation will illustrate the experience and tools development, using case studies, that has taken place in the bio-monitoring of water quality in South Africa. The talk will also point out the opportunities and challenges of using bio-indicators in monitoring water resources and water quality. The presentation will also illustrates the importance of protecting biodiversity, especially in poor or developing countries since that can be the only hope for the communities in these areas or countries.

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Sacramento-San Joaquin Delta Habitat Conservation –Meeting the Ecological Needs of an At-Risk System, Phase I

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Recovery of several federal and state listed fish and terrestrial species populations depends upon improving habitat conditions within the Sacramento-San Joaquin Delta. The decline in winter and spring-run Chinook salmon, steelhead, green sturgeon, and delta and long fin smelt populations has been attributed to major changes in the Delta's hydrology, water quality, and geomorphology (i.e., fundamental estuarine dynamics). Declines in giant garter snake, red-legged frog, Swainson's hawk, greater sandhill crane, vernal pool invertebrates and multiple rare endemic plant species have been attributed to some of the same changes, but are also impacted by population fragmentation, loss of available habitat, and evolutions in land use. Besides functionally changing habitat quality and quantity, the changes in the Delta's environs have also allowed invasive species to take up new niches, altering the food web by increasing competition and predation, and further stressing these declining populations. Moving forward, these impacts are expected to be further exacerbated by sea level rise, changes to salinity and water temperature regimes, and altered annual and inter-annual hydrologic cycles from the anticipated effects of climate change.

Federal and State agencies have initiated a habitat conservation planning effort to provide for the conservation and management of covered species through actions within the Delta that will contribute to the recovery of native species. A critical step to implementation of a successful plan is development of a suite of proactive (e.g.; avoidance and minimization measures) and reactive (e.g.; restoration, preservation) actions, but because the suite of actions targets multiple species, questions remain regarding the effectiveness of the planning effort - simply, will these conservation activities work? The approach to the analyses has integrated complex modeling of the Delta and its tributaries with the best available scientific understanding of the targeted populations, terrestrial biological field surveys, involvement of Delta species and ecological restoration experts, and years of meetings and negotiations leading towards short-term and strategic plans for natural communities and focal species. Both the modeling and the science continue to evolve during the process, yet there are many uncertainties that will likely require an adaptive approach to conservation. This presentation focuses on the approach to develop a comprehensive plan for short- and long-term conservation activities for the Delta ecosystem.

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The Science-Decision Making Interface of the Kissimmee River Restoration Program

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Developing the science to inform decision making for the Kissimmee River Restoration Program has taken many years. Additionally, other critical technical and non-technical information was required in decision making including information developed and provided for engineering, design, water control operations, land acquisition, legal, and policy issues. Following the principles of Adaptive Management, as uncertainties were discovered, methods were devised to reduce each uncertainty so that restoration progress could continue. This paper will focus on how new information developed to address uncertainties was used and conveyed to decision makers to provide for successful application in the decision making process.

The interface between science and decision making was developed and cultivated to serve the needs of the restoration program. The political and public information programs of the day were also served by this interface. In the 1980s when most of this information was being developed, ecosystem restoration was a new concept and decision makers had to be educated in terms of “problems, uncertainties, resolution of uncertainties, options, and recommended actions” and, all of this had to be conveyed over this interface. Over time, this interface became as important as the information itself. This paper will present techniques used to operate at this interface including methods of communicating, targets of communications, and cycles of communications. Some emphasis will be given to the interdependence between technical program elements and supporting staff, elected and appointed officials, stakeholders and special interest groups, NGOs, and the media.

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Biscayne Bay Coastal Wetlands Project Adaptive Management Plan

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A draft adaptive management plan was developed to describe how the CERP adaptive management principles are applied to address uncertainty associated with the Biscayne Bay Coastal Wetlands Project. The draft plan is intended to provide a framework for how ecological response can be utilized to guide future decisions needed to maximize ecological performance within the Biscayne Bay Coastal Wetlands Study area. The plan is also intended to generate new information that will address uncertainties about how this project, and subsequent projects, will achieve desired restoration goals and objectives. The initial plan was developed before, yet is consistent with National U.S. Army Corps of Engineers guidance issued on August 31, 2009 that requires development of adaptive management plans linked to monitoring and assessment for all ecosystem restoration projects. This draft plan describes how key questions linked to restoration project goals and objectives will be addressed by verifying hypotheses identified in conceptual ecological models with monitoring and assessment performance measures focused on key outcomes to determine restoration success. The draft plan identifies potential management options to be cost shared, if U.S. Army Corps of Engineers and the Governing Board of the South Florida Water Management District in consultation with trust resource agencies (e.g., U.S. Fish and Wildlife, Miami-Dade Department of Environmental Resources Management, and Florida Department of Environmental Protection) determine they are necessary to optimize restoration results based on actual assessment results, in consideration of other agency restoration and water management priorities, and if funds are available to implement. The draft plan development also proved to be beneficial in the review and refinement of the Project Monitoring Plan, as the monitoring network had to provide needed information of the appropriate spatial and temporal scales to feed into the adaptive management process.

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Everglades Restoration Adaptive Management Program: Challenges and Solutions

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Large-scale ecosystem restoration programs involve uncertainty regarding how the ecosystem will respond, and how best to achieve restoration goals and objectives in the long-term. For the Comprehensive Everglades Restoration Plan (CERP), adaptive management (AM) was recognized as a necessary tool to address uncertainty in achieving the broad goals and objectives for restoring a highly managed system covering 18,000 square miles, with 68 threatened and endangered species of flora and fauna, and many ecologically unique habitats.

CERP has faced several challenges in implementing its AM program, which was outlined as a strategy in 2006 and further defined in technical guidance developed in 2010 (i.e., the multi-agency developed CERP Adaptive Management Integration Guide and Guidance Memorandum 56). Challenges include: 1) Clarifying decision making and implementation roles; 2) Engagement of and collaboration with non-agency stakeholders; 3) Establishing clear ecosystem restoration goals and objectives and a definition of success that is consistent with multiple mandates; 4) Developing technical tools to support implementation at multiple scales; 5) Achieving institutional change that embraces AM principles; and 6) Sustaining restoration given increased costs and decreased budgets.

This presentation will discuss how the Everglades program has addressed these challenges. Solutions involve: 1) Mapping the CERP decision-making structure, documenting processes, and encouraging clear and timely communication between scientists and managers; 2) Identifying forums that comply with existing public communication laws but provide more opportunity for two-way dialogue with non-agency stakeholders; 3) Using scenario planning and integrating visual tools backed by science to understand tradeoffs and develop solutions to address them; 4) Developing integrated hierarchical tools and process for planning, modeling, data management, and monitoring/assessment; 5) Evaluating policy constraints, recommending solutions, and communicating changes through top-down and bottom-up updates and dialogue; and 6) Phasing project implementation and leveraging, integrating, and optimizing monitoring/assessment efforts.

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Tools to Reduce Uncertainty in the USACE Project Implementation Process

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The U.S. Army Corps of Engineers (USACE) plays a leading role in several national ecosystem restoration programs, including the Comprehensive Everglades Restoration Plan (CERP), the Louisiana Coastal Area Ecosystem Restoration Program (LCA), and the Missouri River Recovery Program (MRRP). The USACE Six-Step Planning Process guides planning and implementation of all USACE civil works projects, including ecosystem restoration projects and programs. Recognizing that ecosystem restoration projects face complex uncertainties, that in some instances exceed those of traditional civil works projects such as flood control and navigation, the USACE guidance on implementing section 2039 of the 2007 Water Resources Development Act (WRDA) requires that an adaptive management plan (i.e., contingency plan) be developed for all ecosystem restoration projects. Guidance developed for the CERP Adaptive Management (AM) Program focuses on how to implement AM strategies and an AM plan within the USACE project planning and implementation process to reduce project uncertainties. However, this AM approach is relevant to other agencies who work as partners with the USACE on restoring ecosystems nationwide.

This poster will describe and compare types of tools and strategies that can be employed during project planning and implementation to reduce uncertainties, along with examples of how they have been applied. Tools include: 1) characterizing uncertainties and their influence on the potential to realize project benefits; 2) pilot-testing of physical models or down-scaled project features to test alternatives and inform project planning; 3) scenario planning to investigate the performance of different alternatives under alternative conditions and improve their performance over ranges of conditions (i.e., robust designs); 4) modeling predictions backed by monitoring and assessment; 5) incremental/modular design to allow for future adaption of project features; 6) flexible operations that can be adjusted if monitoring indicates a need; and 7) contingency options in an AM plan that can be implemented if adjustments are needed. These tools are intended to help support USACE program/project implementation in the face of uncertainty, but are applicable to other agency natural resource and restoration management efforts that utilize the USACE planning process.

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Restoring Functional Oyster Reef Habitat in the Coastal Bays of Virginia

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During the 20th century the coastal bays of Virginia supported some of the most productive oyster reefs along the entire east coast of the United States. Toward the end of that century those oyster reefs and their associated ecosystem services were decimated due to disease or overharvesting. A small partnership of public and private coastal managers, marine scientists, and local community volunteers formed to address state changes in this ecosystem and to plan some of the first ever marine restoration projects in the coastal bays. One of the primary goals set by the partnership was to restore functional oyster reefs for their ecological value as habitat and for their provision of ecosystem services such as water filtration. Initially many projects and restoration techniques were implemented as proof of concepts. With funding from a variety of public and private sources under the NOAA-TNC Community Restoration Program and the Virginia Coastal Zone Management Program's Seaside Heritage Program, 49 acres of oyster reefs have been restored with the deployment of fossil shell substrate. Annual monitoring efforts measure live oyster density, growth rates and mortality, and track the relative success of these restored reefs over time. Innovative techniques and concepts have also been tested with the deployment of two alternative substrates in the form of concrete reef balls and oyster castles. These alternative substrates have proven valuable for evaluation of the suitability of potential restoration sites, small-scale restoration, and immediate provision of three-dimensional structure. With the recent award of a NOAA ARRA grant, the partnership is now at the threshold of bringing oyster reef restoration to the geographic scale necessary to effect positive ecosystem state changes in Virginia's coastal bays.

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The Importance of Reuse Water in Instream and Freshwater Inflows: The Case of Texas

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Water reuse is of considerable interest to those concerned with instream and freshwater inflows, nationwide. Water released from municipal sources composes a large volume of the nation's rivers. In some cases, effluent constitutes a majority of the water in a stream. Water retained for reuse and hence lost from instream flow, however, diminishes this supply. This presents a dilemma in the balance between nature and society, as attaining sustainability of freshwater resources through the reclamation of wastewater effluent may also pose stream flow quantity and quality issues. On the other hand, increasing populations generate greater amounts of municipal wastewater, thereby augmenting the proportion of water returned as instream flow.

In Texas, freshwater flows are currently a major concern for maintaining the health of the state's rivers, bays and estuaries. No standard exists in Texas for preserving specific instream flow levels, though a science and stakeholder-driven process is underway to establish minimum requirements for major river basins. Concerns for instream flows and freshwater inflow are compounded by rapid population growth which adds to water demands. Furthermore, an increasing shortage of freshwater resources in portions of Texas has also led to the rising utilization of reuse water as an indirect water supply source to help meet municipal needs.

For these reasons, Texas poses an interesting case study regarding the nature of water reuse and its consequences to instream and freshwater inflows. In this presentation, we will 1) overview general concerns surrounding reuse impacts on instream and freshwater inflows, 2) analyze related trends concerning population growth in Texas, and 3) discuss implications for instream and freshwater inflows currently and in the future. As freely flowing rivers and healthy estuaries are of primary concern to ecosystem maintenance and restoration, examining this issue is essential to long-term conservation of these resources in a nation-wide context.

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Environmental Management at DoD Facilities in the Chesapeake Bay Region

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The Department of Defense (DoD) is one of the largest Federal land holders in the Chesapeake Bay watershed, managing land on sixty-eight installations and training areas, such as Fort Meade, Aberdeen Proving Ground and Joint Base Andrews, as well as eighteen U.S. Army Corps of Engineers reservoirs. DoD is committed to environmental stewardship and sustainability, as seen through the many initiatives developed over the past several years. The purpose of this presentation is to highlight how the U.S. Army Corps of Engineers, Baltimore District, Planning Division, is assisting these facilities meet their Chesapeake Bay restoration and preservation commitments.

Several DoD facilities in the bay watershed have developed natural resource programs to not only manage the resources on base but also manage their impacts to neighboring resources in the immediate area and the watershed. Installations have undertaken such projects as invasive species surveys and management plans, stream assessments, wetland delineations and integrated natural resource management plans manage their land and minimize mission impacts to the surrounding environment.

Water resource management is one of the most integrated and inventive programs on DoD facilities in the Chesapeake Bay, particularly water quality and quantity in relation to stormwater. As facilities further develop, low impact development, regenerative stormwater conveyances, and other best management practices are being implemented for retrofits and new construction. Stream and wetland restoration activities are numerous to mitigate for impacts and to address habitat, water quality and water quantity concerns. Some facilities have implemented several restoration activities to promote fish habitat and submerged aquatic vegetation, while mitigating for their past impacts and enhancing their shorelines. Other facilities are looking at projects such as daylighting streams to improve water quality and habitat, developing mitigation wetlands to offset impacts of development, and upgrading their stormwater systems to handle increased flow from development. Facilities are also looking towards best management practices that serve multiple functions, such as water quality improvement, water storage and habitat creation.

While DoD is committed to environmental stewardship on their facilities, coordination is frequent with other agencies, non-profit groups, universities and other stakeholders. Facilities manage their resources as an integrated part of the entire watershed, looking beyond their fenceline.

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ICEM-CTK: An OWL ontology for Building Conceptual Ecological Models

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Ecosystem-based management (EBM) is a process that integrates, biological, social, political, and economic factors into a comprehensive strategy to sustain ecological services. EBM has become the popular and modern approach to managing natural resources, but actually doing EBM requires a science-based consensus about the defining characteristics and fundamental regulating processes of the system to be effective and sustainable. The U.S. Environmental Protection Agency (USEPA), National Oceanic and Atmospheric Administration (NOAA), and other agencies involved in ecological or ecosystem-based management projects often rely on the use of Conceptual Ecological Models (CEM) to represent ecosystem dynamics. When combined with consensus qualitative goals and associated Quantitative Ecosystem Indicators (QEIs), CEMs can form the foundation of a powerful decision support system for EBM.

While there are currently some existing standard frameworks for building CEMs, the most prominent being the DPSIR framework (Driving forces, Pressures, States, Impacts, Responses), originally introduced by the European Environment Agency (EEA), there is no standardized vocabulary to use with these frameworks, nor a standard method of representation. Models are typically represented using static diagrams with accompanying text, preventing the models from being directly used by a computer programming language, or an existing software application. In order to increase reusability, facilitate adoption and enhancement of the models, we have developed an Integrated Conceptual Ecological Model building toolkit (ICEM-CTK), based on the DPSIR framework, which provides a standard computationally accessible representation with which to build and encode CEMs. This toolkit enables models to be stored in a database and used by software applications for whatever purpose desired. ICEM-CTK allows models and data to be compared between independent groups provided those groups have created their models and linked their data using ICEM-CTK. ICEM-CTK also enables the integration of independently produced sub-scale or sub-process models into larger-scale ecosystem models. The toolkit is encoded in a portable, computationally accessible, language called OWL (Web Ontology Language), a W3C standard language used for knowledge representation. It has been applied to

ICEMs developed by the NOAA-funded Marine and Estuarine Goal Setting for South Florida (MARES) project. Using this example we will discuss how these models can then be used by search and decision support applications to support EBM.

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Amite River and Tributaries Ecosystem Restoration

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The Vicksburg District, U.S. Army Corps of Engineers is conducting a study to determine the feasibility of ecosystem restoration in the Amite River watershed. A component of this study is an effort to document land use and habitat changes that have had a dramatic affect on the Amite River and its riparian landscape. The focus of the feasibility study is to determine ecosystem restoration opportunities from a watershed approach that will benefit the multiple uses of the river.

The Amite River and its tributaries flow from Mississippi through the western "Florida" parishes of southeast Louisiana and into Lake Maurepas, an oligohaline lake that drains into Lake Pontchartrain. The major rivers in the study area are the Amite River and the Comite River. The Amite River is used for recreation, propagation of fish and wildlife, and to a lesser extent, for water supply, navigation, and waste disposal. A section of the Amite River in East Feliciana Parish, from the Louisiana/Mississippi state line to Louisiana Highway 37 (LA 37) and a section of the Comite River in East Feliciana and East Baton Rouge Parishes, from LA Hwy 10 to White Bayou, are included in Louisiana's Natural and Scenic Rivers System.

Prior to mining, the Amite River contained a diverse composition of reaches ranging from single-thread meanders to two or more bifurcating channels and secondary channels to some nearly braided sections. Over the period from 1940 to 2010, there were large decreases in pasture (-7,791 acres) and forested habitat (-13,150 acres) and increases in silviculture (9,871 acres), mining areas (4,584 acres), mining pits (2,298 acres), development (2,439 acres), and sandbars (1,172 acres). It is estimated that approximately 676 acres of wetlands, approximately 22 percent, have been lost in the study area. Most of the loss of the forested areas was to silviculture and mining activities. Sandbars increases were due to presence of mining activities near the river.

The Corps is investigating multiple non-structural and structural alternatives to restore the project area to pre-disturbance conditions. These alternatives include secondary channel reconnection, forested riparian corridors, channel deepening and abandoned mining area reclamation.

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Integration of Engineered Bank Stabilization Design Elements to Supplement Habitat Restoration Goals

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Mercury (Hg) was used between 1929 and 1950 at a textile manufacturing plant in Waynesboro, Virginia, and was released and transported into surface water, sediments, soils, and biota of the South River. In the 1970s when fish tissue Hg concentrations were found to be elevated relative to background, it was believed that the Hg in the aquatic system would naturally flush out and that Hg levels in biota would begin to decline. However, Hg concentrations in some fish species in the South River have remained stable compared to tissue levels observed in 1978.

Many hypotheses have been formulated about why Hg levels in fish tissue have remained elevated. A leading hypothesis is that Hg releases from the plant accumulated in depositional areas along the river and floodplain, including river banks. Changes in hydrology and poor land use practices have resulted in erosion of these deposits and remobilization of the associated Hg, making it available for methylation. Elevated concentrations in river banks have been documented. A bank stabilization pilot was constructed along a 500-ft reach of the South River to test this hypothesis and to assess whether control of Hg loading to the water column and sediment through eroding banks will result in reductions of Hg concentrations in the aquatic environmental compartments.

Specifically, the objectives of the pilot are to: reduce erosion of Hg-contaminated river banks along the pilot reach, to assess whether reducing erosion resulted in reduced Hg concentrations in the physical and biological compartments within the river in the vicinity of the pilot, and to determine if the Hg methylation environment in adjacent sediment changed appreciably. A secondary objective of the pilot is to incorporate design elements that will integrate the enhancement of existing riparian and in-stream habitat functions that have deteriorated as a result of bank erosion. These design elements include a cobble, gravel, rock toe to enhance benthic habitat, large woody debris to provide escape and cover habitat for aquatic fauna and subsoil filled lifts to act as a substrate for native riparian vegetation on the bank slope and at the top of the bank.

Baseline monitoring including erosion measurements and Hg concentration measurements in soil, sediment, pore water, and clams was performed prior to construction of the pilot, which was completed in December 2009. Post-construction monitoring is currently underway and will continue through the end of 2010, with supplemental monitoring thereafter. The bioengineering design and construction of the pilot will be described that includes restoration elements. A comparison of pre- and post-construction monitoring data including improvements in habitat enhancement elements will also be presented.

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The Successful Use of Large Woody Debris for Bank Stabilization on the Connecticut River

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Bank stabilization projects along the Connecticut River in northern Massachusetts and southern Vermont have used both hard and soft engineering techniques in an effort to stabilize high banks composed of fine-grained sandy soils. Significant flood events (the Bankfull capacity is approximately 110,000 cfs, and spring freshet flooding is typically 65,000 cfs), boat wakes, fluctuating water levels, past land use farming and logging practices, and the construction of multiple dams within the Connecticut River watershed over the past 150 years are likely to have influenced bank erosion. In the 1970's the U.S. Army Corps of Engineers used several configurations of stacked car tires to stabilize over 1000 linear feet of eroding shoreline; stone rip has been placed on many sections of the river; and since 1995, soil bioengineering techniques have been used to stabilize eroding shorelines. While the bioengineering work has been successful, these techniques relied on a stone toe of slope and erosion control materials and vegetation on the slope above to stabilize the eroding banks. In an effort to eliminate the use of stone to provide natural shoreline habitat, we initiated demonstration projects in 2009 to stabilize the eroding shoreline using engineered woody debris. In 2009, approximately 1735 linear feet of shoreline was built, and in 2010 approximately 1200 linear feet of shoreline was constructed. An additional 3,000 linear feet of work will be built over the next three years.

Woody debris log jams were built at a spacing of approximately 120 feet on center and secured into the banks to anchor the planned sediment accretion formations. Native emergent and aquatic vegetation were planted between the log jams to help in the retention of sediment, and to provide wildlife and fisheries habitat. Staff gages, and scour chains were installed vertically along the project's aquatic bench to measure accretion or deposition. To measure bank erosion, bank pins consisting of metal welding rods were installed horizontally into the banks. During the first year of monitoring, the woody debris structures accumulated over 6 inches of new sediment by reducing water velocity along the shoreline during flood events. There was no measured bank erosion in an area which previously eroded between 1'-3' annually.

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What Determines whether or not Adaptive Management Programs Affect Management and Policy Decisions?

David Marmorek, Lorne Greig, Carol Murray and Don Robinson

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Adaptive management (AM) is a rigorous approach for learning through deliberately designing and applying management actions to maximize learning. Management decisions involve choosing among competing alternatives in a manner that best balances competing objectives and societal values. AM, like all science, is only one input to decisions. For an AM program to affect decisions (“closing the loop”), its outputs must lead to a different choice (or form of implementation) of actions than would have occurred without the AM program. Since we never have a perfect experimental design to evaluate this question (i.e., a meta-AM experiment with multiple treatment-control ecosystem pairs, each with similar sets of decision makers, with the treatment ecosystem of each pair managed with AM and the control ecosystem managed without AM), all of our inferences are subjective. But these inferences are based on three decades of experience with AM successes and failures across North America, and two recent studies we led (involving many AM practitioners) examining the factors enabling and inhibiting AM. We will provide concrete examples of AM successes and failures to support our hypotheses, and a score sheet for assessing the probability of success of an AM initiative.

Five *critical* factors affect the likelihood of closing the AM loop and affecting management decisions: 1) a social context that requires and supports the implementation of AM (i.e., uncertainty over management of a complex problem which creates the need for AM, and sufficient trust and commitment to implement all six steps of the AM cycle); 2) leadership and organizational cultures committed to learning at multiple levels; 3) an executive mandate to implement AM; 4) a problem definition which invites creative exploration of alternative actions; and 5) effective communication with the public, across disciplines, and between science and policy realms. If these five critical factors are in place, it’s likely that four other *necessary* pieces of the puzzle can also be established: community involvement, planning, funding, staff training and the conduct of science. AM programs at larger spatial / temporal scales inevitably involve more players, competing objectives and experimental design challenges, making it more challenging to establish the above critical and necessary conditions.

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Setting Restoration Targets in Florida Bay using Paleoecology and Salinity/Hydrology Models

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Water management projects that began in south Florida in the early 20th century have negatively affected the salinity regime and subsequently the ecology in the downstream Florida Bay estuary. A primary goal of the Comprehensive Everglades Restoration Plan (CERP) is restoration of the quantity, timing and distribution of freshwater delivered to Florida Bay resulting in more natural estuarine conditions. To-date, performance measures and targets that reflect natural hydrologic conditions have utilized a combination of paleoecologic analyses, output from a regional hydrologic model, and best professional judgment. A three-phase method was developed linking improved paleoecologic evaluations and linear regression (MLR) models that provides greater confidence in paleo-based flow and stage estimates (Marshall, Wingard, and Pitts, 2009).

To begin the process, molluscan faunal assemblages are analyzed from sediment cores collected in the estuaries and compared to an extensive dataset on salinity preferences of living mollusks. Species weighted average salinity estimates are calculated for each sample from the sediment cores to estimate the ~1900 AD average paleosalinity. In the second phase, statistical models are used with the ~1900 AD paleosalinity to develop a time series that simulates daily and seasonal variability. Linear regression models (LRMs) are developed from long-term observations in freshwater wetlands (flow and stage) and estuaries (salinity). The third phase couples the ~1900 AD paleosalinity time series with the LRMs to predict the hydrologic regime that will establish the pre-drainage salinity regime within Florida Bay over a 36-year period of varying climate given the current landscape in the Everglades freshwater marshes. The useable products for performance measure purposes are monthly and seasonal water delivery targets for flow, stage, and hydroperiod restoration in the historical Everglades and salinity in Florida Bay.

Five studies using the linked paleoecological data and models procedure have been performed in Florida Bay at Whipray Basin, Rankin Lake, Russell Bank, Little Madeira Bay, and Crocodile Point. When the results are conservatively interpreted the paleo-based flow in Shark River Slough is about 2-2.5 times the average existing flow, and about 3-3.5 times the average existing flow in Taylor Slough based on observed data from the past 2 decades. In addition, Taylor Slough flows are more deficient than Shark River Slough flows towards the end of the dry season. The mean paleo-based flows in Shark River Slough and Taylor Slough are estimated at about $2775 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$ and about $200 \times 10^6 \text{ m}^3 \text{ yr}^{-1}$, respectively. The paleo-based increase in Shark River Slough water level is about .25m (110% of current depth), and the increase in Taylor Slough is about 0.31m (180% of current depth). Across the Bay the paleo-based salinity regime is lower than the current salinity conditions. Mean paleo-based salinity values are about 10 salinity units less than observed values for the North, Northeast, and Central Regions of the Bay and about 5 salinity units less for the South and Central Regions. These values can be used as guidance for CERP hydrology and salinity performance measures and targets in Florida Bay.

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Integrated Sustainable Water Management for California: Addressing Current Physical and Institutional Challenges to Meeting Future Needs

Gary Bardini and Mike Mierzwa – presented by **Paul Marshall**

California Department of Water Resources, Sacramento, CA, USA

Panel Overview:

The Bay-Delta is California's hydraulic heart with very valuable, but fragile ecosystem, conveyance, and flood systems. Despite significant Federal spending and a comparable State share over the past 15 years, the ecosystem has continued to deteriorate. Continuation along the same path is not a viable option. The risks remain real – imperiled water supply for 25 million residents, scant irrigation water for 9 million acres of the nation's most productive farmland, and threatened critical energy and transportation infrastructure that supports the 8th largest economy in the world. In addition, there are fifty-five (55) ESA-listed species in the Delta. These risks transcend the California legal Delta boundaries, and they need to be considered as part of an overall system that encompasses natural and engineered waterways, regional environmental health, public safety, and national, regional and local economic livelihood. One must also consider the political context created as a result of Federal, State and local government responsibilities and the myriad of interested stakeholders.

Presentation Summary:

Mr. Gary Bardini, Division of Flood Management Chief at the California Department of Water Resources, will be the third speaker in a moderated panel discussion entitled "A Systems Perspective on Addressing Water Resources Challenges in the Sacramento – San Joaquin Bay Delta," providing the state perspective.

Population growth and changes in land use, water use needs and priorities, and the timing and distribution of precipitation have placed increasing stresses on California's aging water management infrastructure. Recognizing institutional challenges, the State of California is working on developing a new strategic approach towards supporting system-wide sustainable water management. This presentation will identify these challenges and highlight efforts currently underway within the California Department of Water Resources to promote integrated water management through cooperation between local, state, and federal water resource agencies. Key topics include an overview of future planning efforts as well as proposed new state programs designed to promote interagency cooperation.

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Bioremediation's Integral Role in Ecosystem Restoration and Rehabilitation

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Restoration and rehabilitation of an ecosystem involves manipulation of the system's key components (i.e., soil, sediment and water chemistry as well as biotic assemblage) to achieve a composition, structure, and function similar to the pre-disturbed condition. Conventional remediation technologies (other than bioremediation) used for *in situ* and *ex situ* remediation of contaminated sediments and soils are typically expensive and potentially destructive prior to the recovery period. These include solidification and stabilization, soil flushing and washing, electrokinetics, chemical reduction/oxidation, low temperature thermal desorption, incineration, vitrification, pneumatic fracturing, excavation/retrieval, and landfill/disposal.

Recently, the role of bioremediation in ecosystem restoration has been studied by an increasing number of scientists from various disciplines. Bioremediation is the integrated management of contaminated aquatic or terrestrial ecosystems with specific organisms to reduce risks by catalyzing preferential transfers and transformations of contaminants of concern. The objective of this presentation is to discuss the current and future roles of bioremediation in the integrated management and reclamation/rehabilitation of contaminated project sites. For example, introduction of wild plants to metalliferous soils, genetic engineering of plants for enhanced synthesis and exudation of natural chelators into the rhizosphere, and use of hyperaccumulators has become part of the integrated plan for serpentine soils and mine tailings.

In the summer of 2009, aerobic and facultative microbes were used as the first step in the Woodlands Lake (Woodlands, TX) habitat rehabilitation project. Bioremediation was implemented *in lieu* of alternative treatment strategies including aeration, chemical algicide applications, and mechanical removal of nutrient-saturated surficial sediments. Through a site-specific feasibility evaluation, naturally occurring microbes were selected for their ability to breakdown organic compounds and sequester phosphorus from this eutrophic lake subsequently decreasing odors associated with dead and decaying blue-green algae blooms. A significant decrease in odors was observed within three days of microbial application and no remnant algae bloom was measured within three weeks of application.

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Results of the Independent, External Quality Assurance Review of Models Used for Ecosystem Restoration Project Planning and Management

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In 2003, the U.S. Army Corps of Engineers (USACE) Planning Models Improvement Task Force put forth a series of recommendations to improve the ability of the Corps to produce high-quality investment decision documents. Among the recommendations were several related to the assessment of planning models used by USACE planners to develop information intended to inform investment decisions associated with the Nation's water resources infrastructure and natural environment. The primary charge to the Planning Model Improvement Task Force was to put in place "a process to review, improve and validate analytical tools and models for USACE Civil Works business programs," the requirements of which are defined internally by USACE *Planning Models Improvement Program: Model Certification* guidance (EC-1105-2-407) and by Section 2034 of the 2007 Water Resources Development Act (WRDA).

We will summarize information from greater than five years of independent external peer reviews of ecosystem restoration planning models and evaluation techniques. We will discuss the review procedures implemented to date to ensure that reviews are thorough and focused on the technical quality, system quality, and usability of planning models as described in the USACE *Protocols for the Certification of Planning Models*. Key findings and common themes across reviews will be presented, the success of review teams in concurring on resolutions to key issues will be discussed, and examples will be provided of remedies adopted by planning model proponents in their efforts to maintain project momentum and ensure that management decisions are grounded in appropriate interpretation of frequently imperfect data.

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Adapting to Rising Tides: San Francisco Bay Area Climate Change, Vulnerability, and Risk Assessment

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A pilot study in San Francisco Bay (focused in Alameda County) is being conducted to assist regional and local transportation and planning agencies, as well as communities, to better understand the risk sea level rise is posing on San Francisco Bay Area transportation infrastructure. Although the focus of this study is on the vulnerability of transportation assets, such as freeways, seaports, railroads, and airports, the study also includes an assessment of the Bay's shorelines, including shore protection and wetlands, as these assets play an important role in protecting inland infrastructure.

The San Francisco Bay Area is home to approximately seven million people, and although sea level rise is occurring slowly over time, and we think we have sufficient time to respond, it is unlikely that we will move away from all the low lying land around the Bay. Significant investments have been made in these areas, and these investments are expected to last for 100 years or longer. With predicted sea level scenarios of up to 55 inches by the end of the century it is critical to begin acting now. To do so effectively, decision makers need to be informed about the assets at risk and the possible adaptation options and solutions. This pilot study is utilizing the Federal Highway Administration's (FHWA) risk assessment model to provide a framework for assessing the vulnerability, importance, and redundancy of transportation assets with respect to climate change. This collaborative planning pilot project will produce a fine-grained assessment of vulnerabilities to sea-level rise (SLR), identify implementable strategies to address those vulnerabilities and thus continue to advance regional goals for transit-oriented focused growth.

Floods in the US and throughout the world have taught us how critical transportation infrastructure is. Along sea level rise, climate change is expected to bring storms of increasing intensity and frequency—with the 100-year storm event of today potentially becoming the 10-year event of the next century. Temporary inundation of roads, or even a small section of a road, can have a large impact on the mobility of goods and people and therewith the economy. In a catastrophic event the same infrastructure should be available for emergency response and possibly evacuation. It is important to understand these risks and define what is considered critical infrastructure. A key outcome of this study is to understand how good the FHWA model is at helping to identify which assets are truly at risk, which need major investment for protection or relocation to prevent chronic disruption, and which assets are critical in catastrophic situations as well as to the long-term economic sustainability and safety of the region.

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Urban Wetland and Stream Restoration in the Hudson-Raritan Estuary (HRE)

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Before their restoration, the Kane Wetlands, located within the Hackensack Meadowlands in New Jersey, were severed from the adjacent Hackensack River's tidal influence by berms and tide gates, littered with debris, and dominated by invasive vegetation, which limited wildlife habitat and public enjoyment. The site is identified as a restoration site in the *HRE Comprehensive Restoration Plan*. The design and construction of this restored wetland is reestablishing high-value fish, wildlife and plant habitats, improving sediment and water quality, and providing opportunities for ecotourism and public enjoyment. They also provide many "lessons-learned" for urban restoration projects.

On behalf of the Meadowlands Conservation Trust and EarthMark Mitigation Services (a public-private partnership), The Louis Berger Group designed the restoration of the ~240-acre Kane Wetlands, which are being used by NJ transportation agencies to offset wetland impacts from critical projects. The design included technical challenges not commonly encountered in wetland restoration projects. First, a gas pipeline bisected the site, so two pipeline sags were designed to allow tides to safely flow over it. Second, the Kane site had sunk below tidal marsh elevations, because historic berms and tide gates had removed tidal influences, so an extensive tidal creek network was designed to bring in the tide and generate soil to raise the large marsh plain elevation. Third, the site is surrounded by low-lying properties subject to flooding. Therefore an innovative Concertainer berm (a technology never before used in NJ) was employed to protect these adjacent lands from the tidal flooding that would occur after the removal of pre-existing berms on the Hackensack River. Fourth, the project faced unprecedented scrutiny from the Federal Aviation Administration due to concerns about improving wildlife habitat at a site located near Teterboro Airport.

Finally, the regulatory agencies also required a Baseline Ecological Risk Assessment (BERA) of both existing and proposed site conditions. The detailed BERA indicated that the site currently posed little risk to fish and wildlife and that the proposed restoration would not increase the risk to any organism. However, the U.S. Fish and Wildlife Service required that the Kane restoration improve the sediment ecology rather than just the plant ecology (the standard of past restorations), which in practice lead to the removal of soil tainted with low levels of mercury (<3.5 mg/kg) from the Kane Wetland that would previously have been considered acceptable.

Construction, including the removal of 4,000 tons of sediment, was completed in late 2010. After 100 years of human-made separation, the Kane Wetlands are now openly flowed by the tidal waters of the adjacent Hackensack River. Post-construction sampling confirmed that mercury tainted sediments have been removed. As required by the regulatory agencies, sediments, fish, invertebrates and spiders will be sampled and analyzed for five years. The data will be used to conduct a BERA each year to confirm that the site poses minimal risk to fish and wildlife.

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Information Needs and Difficulties with Floodplain Management

Kat McCain

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Several advances in ecological theory have aided in understanding large river floodplains; however, practitioners are still faced with difficulties and desire more information in order to improve management of these complex ecosystems. To learn the information needs and difficulties faced by practitioners, the Missouri Department of Conservation administered a 16-question online survey to area site managers. Ninety-seven conservation areas in close proximity to the larger rivers in Missouri were surveyed to address two overall objectives: (1) to determine questions, uncertainties, and management issues faced by site managers, and (2) to determine what information site managers needed to better manage their areas into the future. Seventy-five surveys were returned, and site managers emphasized the need for detailed topography for improved water level management and better tools for invasive plant control. In addition, the key difficulties plaguing floodplain managers in Missouri included the unpredictable nature of flooding, altered flow regimes, and socio-political factors involving neighbors. A two-question version of the survey was mailed to 11 U.S. National Wildlife Refuges located in the Upper Mississippi River watershed in order to gain an additional perspective. Six surveys were returned and refuge managers highlighted invasive species (aquatic and terrestrial) as the primary information need and difficulty with floodplain management. The Missouri Department of Conservation plans on using these data to design a research project, in the context of adaptive management, to test ecological theory and answer the needs of floodplain practitioners.

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Restoration of Vessel-Induced Seagrass Habitat Injuries in Biscayne Bay, South Florida: Preliminary Monitoring Data and Recommendations for Future Projects

Anne S. McCarthy and **Deborah K. Fawcett**

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Shallow water seagrass habitats in south Florida are susceptible to anthropogenic injuries from altered hydrology, algae-blooms from nutrient enrichment, and vessel operations that can cause physical damage to the below-ground biomass from propeller scarring and groundings. Recovery times for the vessel-induced seagrass habitat injuries vary depending on the geometry, size, severity, and location. Recovery times for propeller scars, typically <1 m in diameter, range depending on the depth and severity of the scar, but are estimated to take up to 7.6 years (Andorfer and Dawes, 2002). For larger injuries that often include deep holes in the seagrass bed (“blow holes”) where sediments have been displaced and the rhizome and root mat has been destroyed, recovery occurs more slowly (National Oceanic Atmospheric Administration and Florida Department of Environmental Protection, 2004) and may even take several decades without the aid of restoration actions (Fonseca et al., 2004).

A large-scale seagrass mitigation program in south Florida was implemented to offset impacts from a beach nourishment project. In two separate phases occurring in 2008 and 2010, 80 individual seagrass injuries (propeller scars and blow holes) located in *Thalassia testudinum*-dominated habitats were treated with one or more restoration methods depending on the shape, size, location, and depth of the injury. Restoration methods included seagrass transplantation (1.5 transplants/m²) from donor sites (≤ 1 core/m²); installation of bird stakes to allow for the regular release of natural fertilizer from roosting birds over an area of approximately 3 m²; and/or sediment fill with compatible carbonate sediments to bring the injury to grade with the surrounding habitat.

Phase I restoration efforts occurred in 2008, with 55 propeller scars in southern Biscayne Bay within the Florida Keys National Marine Sanctuary receiving seagrass transplants and/or bird stakes to encourage natural recovery and re-colonization. In 2010, Phase II efforts included the placement of loose and bagged sediments and the installation of bird stakes into 35 blow holes located in the northern and southern portions of Biscayne Bay Aquatic Preserve.

To determine the relative success of the restoration efforts, a 5-year monitoring program was developed to evaluate success criteria. Monitoring program parameters and the schedule were selected based on the restoration method and success criteria. To date, preliminary results of Phase I restoration efforts indicate sites are trending toward recovery. Mean *T. testudinum* density (short shoot/m²) in the planted and staked sites has steadily increased since the baseline survey and is approximately 28% of the mean density estimated within the reference area after 2 years.

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Use of a Medical Model to Diagnose and Treat Ecological Systems

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Medical practice provides an effective model for decision support for management of species and ecosystems. Physicians diagnose illness based on a presentation of conditions from the patient. The patient's conditions are evaluated against a reference or template condition appropriate to the age, sex and other intrinsic attributes of the patient. Based on differences between patient and template, the physician diagnoses the condition and devises a treatment plan. This differs from an experimental approach characterized by hypothesis testing, experimental design and replication. Features of medical practice also characterize natural resource management. Clinical practice and resource management both rely on experimentally derived knowledge to develop timely treatment plans reflecting patient needs. However, statistically based experiments are rarely treatment options for clinicians or managers. We extend the medical model to create a basis for decision support for natural resource managers under the concept of ecosystem diagnosis and treatment. Diagnosis of the patient (current) condition is made relative to a reference or template condition that captures properly functioning conditions given the climatic, geological and biogeographical attributes of the system. This is the basis for evaluation of conditions reflecting the intrinsic nature of the system. The technique has been successfully applied to the management and restoration of salmonid freshwater ecosystems and has been extended to address estuarine environments for other fish species.

A case study will be discussed regarding application of the Ecosystem Diagnosis and Treatment concept to the development of an integrated habitat restoration program for salmon habitat in the Okanogan River (Columbia River, northeast Washington State). The river historically produced abundant runs of Chinook salmon and steelhead trout (*Oncorhynchus spp.*) supporting tribal and non-tribal economies. Deterioration of conditions within and outside the watershed markedly reduced fish abundance leading to species listing under ESA. We have applied the Ecosystem Diagnosis and Treatment concept and the notion of patient-template analysis to develop a decision support system for the Colville Tribe for management of habitat in the Okanogan River. The system incorporates existing observational and experimental knowledge within a spatially explicit fish life-history framework that views the system "through the eyes" of species; different species provide multiple views of the system. In the Okanogan, the presentation of current (patient) condition is based on detailed field surveys. The reference (template) condition was derived from geomorphic principles and historic accounts. The patient condition is updated annually to reflect new information, survey data and restoration projects. The system provides managers with a diagnosis of the river to guide habitat restoration investments, size and manage an associated fish hatchery and set annual harvest targets. The system is linked to on-going health monitoring and annual "check ups" that create action plans for the coming year. System health metrics chart progress toward goals and evaluate the need for adjustments to strategies. The result is a scientifically based management plan with explicit mechanisms to adjust actions and maintain a trajectory toward goals.

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Environmental Compliance and Development of a Compensatory Mitigation Package for the Masonville Dredged Material Containment Facility Project

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The Masonville Dredged Material Containment Facility (DMCF) was designed to accommodate Baltimore Harbor dredged material, which is statutorily required to be placed in a confined disposal facility. Limited options for placement facilities in Baltimore Harbor led the Maryland Port Administration (MPA) to develop an in-water facility that required the fill of 141 acres, including 130 acres of tidal open water, 10 acres of upland within the Chesapeake Bay Critical Area, and one acre of wetlands. To evaluate project impacts, an environmental impact statement was prepared in accordance with the National Environmental Policy Act (NEPA) and a compensatory mitigation plan was developed to offset identified project impacts. The compensatory mitigation package centered on the ecosystem-level restoration of the adjacent Masonville Cove, which is a Baltimore City Designated Habitat Protection Area. The mitigation package also incorporated both in- and out-of-kind mitigation projects vetted through the Bay Enhancement Working Group, which is composed of state and federal resource and regulatory agencies. A site-specific habitat condition analysis was developed to assess the sufficiency of the compensatory mitigation package, which included substrate improvement, wetland creation and enhancement, stream restoration, and trash interceptors. Despite the many regulatory challenges, the approvals and permits necessary to begin construction were obtained within 28 months of public scoping due to the Port's collaborative decision-making process, which incorporated numerous stakeholders and regulatory agencies in the development of the project and mitigation package. All permits required for operation of the DMCF have been obtained and the facility is currently operational. Restoration of Masonville Cove and the design and implementation of the other mitigation components are ongoing.

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Test Your Soil First: Managing Phosphorus at the Home Site

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Columbia is a planned community that consists of ten self-governing villages, located in Howard County, Maryland. Situated between Baltimore – Washington, Columbia straddles the US 95 corridor. With a population close to 100,000 residents and a land area of 28 mi², Columbia is one of the largest planned communities in the nation. There are 34,000 housing units in Columbia with 66 % owner occupied, the remainder being rentals.

All of Columbia drains to either the Middle or Little Patuxent Rivers and ultimately the Chesapeake Bay. There are three artificial lakes in Columbia, Wilde Lake, Lake Elkhorn and Lake Kittamaquandi, created by damming of tributary streams during town construction. The three lakes, as with most urban lakes, are eutrophic and plagued with excessive algal and macrophyte growths. The Columbia Association, Columbia's non-profit service organization, manages the macrophytes and denser filamentous algal blooms with aquatic weed harvesters.

Test Your Soil First is CA's first attempt to reduce phosphorus inputs to the lakes and ultimately the Chesapeake Bay from resident's lawns. Using the Village Association offices as soil sample kit pick up and sample drop off points the partnership is providing free soil sampling to residents. The Keith Campbell Foundation for the Environment has provided funding for soil test analysis. The first year's goal is to provide soil tests for 1000 residents or about 7% of the single family homes..

As the soil samples results return from the lab, CA is mapping the results. Results displayed yard by yard will show hot spots through out Columbia. The Howard Soil Conservation District, using the Village Association offices, will provide information on interpreting results, proper lawn care, and the use of phosphorus free fertilizer based on soil test results.

The soil test results and mapping will provide the basis for management decisions by CA and regulatory decisions at the county level related to eliminating the use of phosphorus on lawns in Columbia.

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Assessing Resilience of Coastal Ecosystems

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With over 30 percent of the total United States population residing in coastal counties and expected rates of sea level rise of 0.4 - 4.9 feet per century, the need for integrated planning of coastal systems has never been more pronounced. Given these uncertainties and risks, many scientists have emphasized the need to develop integrated coastal systems that are resilient to both short- and long-term disturbances (e.g., coastal storms and sea level rise, respectively). Resilience is the ability of a system to absorb or recover from disturbance and consists of three primary components: (1) resistance against regime change, (2) recovery and response to disturbance, and (3) adaptive capacity. This presentation will review the history of “resilience thinking” as well as ongoing efforts by numerous agencies and entities to enhance and quantify resilience. Moreover, the role of ecosystem restoration in contributing to coastal system resilience will be highlighted through examples and case studies.

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Recovering Endangered Fish in the San Juan River—Snatching Success from the Jaws of Nonnative Fish

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The San Juan River Basin is the second largest of the three sub-basins that comprise the Upper Colorado River Basin. From its origins in Colorado, the San Juan River flows approximately 560 km to Lake Powell, intercepted along the way by Navajo Reservoir where the water is stored for use in the San Juan and Rio Grande basins and for delivery to the lower Colorado River Basin. The San Juan Recovery Implementation Program (SJRIP) was begun in 1992 and authorized by Congress in 2000 to protect and recover endangered fishes (Colorado pikeminnow [*Ptychocheilus lucius*] and razorback sucker [*Xyrauchen texanus*]) while allowing water development to proceed. The SJRIP is a nationally recognized effort which has served as a model to address other Endangered Species Act issues throughout the country. Aggressive efforts are being implemented through Program Elements and comprehensive plans to: construct fish passages, fish screens, and propagation facilities; restore and enhance aquatic habitat; improve water use efficiency; stock native fish and control non-native fish species; and conduct hydrologic evaluations that allow the adoption of natural-flow mimicry. All activities conducted through the SJRIP are evaluated by two technical committees (Hydrology and Biology) comprised of experts in endangered fish management, fish ecology and biology, geomorphology, hydrology, and habitat management. A Coordination Committee oversees the activities of the two technical committees and has ultimate responsibility over recovery actions. The Bureau of Reclamation and U.S. Fish and Wildlife Service work cooperatively to carry out the management activities approved by the Program participants. To ensure a scientifically defensible approach to recovery actions, the SJRIP uses permanent peer reviewers to evaluate progress of the individual projects and the Program as a whole. Management activities are formulated in an adaptive management framework whereby specific actions are conducted and subsequently monitored to inform, and modify, future activities. The adaptive management approach has allowed the SJRIP to make progress towards recovery in the face of uncertainty about various aspects of the biology and ecology of these endangered species. Monitoring efforts since 2000 have shown dramatic increases in the composition of the native fish community as well as concurrent, but negative, shifts in the nonnative fish component. The Department of the Interior recognized the SJRIP and its sister program, the Upper Colorado River Recovery Implementation Program, with a Cooperative Conservation Award in 2008, citing the programs' excellence in conservation through collaboration and partnerships.

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Adaptive Management in Everglades Restoration: Decompartmentalization of Water Conservation Area 3

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The overall goal of adaptive management is to substantially improve the chance of restoration success at the project and system levels when there is uncertainty about how to achieve project goals. Adaptive management recognizes that natural systems such as the Greater Everglades, and other large-scale restoration programs around the country, are remarkably complex and difficult to predict. Numerical models currently lack the predictive power to accurately characterize ecological responses to the implementation of restoration programs. These uncertainties create great challenges for managers who must decide on actions to achieve restoration goals.

Water Conservation Area (WCA) 3 Decompartmentalization and Sheetflow Enhancement Project (Decomp) is critical to the Comprehensive Everglades Restoration Plan (CERP) restoration success because of the importance of reversing the widespread and continuing ecological degradation of the core Everglades' ridge and slough and southern mangrove ecotone, and eastern/central Florida Bay, including beginning the recovery of the once-abundant animals that characterized the region. Decomp has been the first major CERP project to incorporate adaptive management principles into planning and has adaptive management activities and milestones in the project's tracking schedule. This presentation will discuss how adaptive management is being used in Decomp in order to: 1) find the best restoration design without violating constraints; 2) combine data mining, historical analysis, physical models, evaluation tools, and phased implementation as strategies to address specific scientific uncertainties and incorporate new information; 3) use a multi-agency collaborative approach (with stakeholder input); 4) increase understanding of system responses to various activities; and 5) select the optimal project alternative(s).

The Decomp adaptive management program has both active (e.g., the Decomp physical model, which is a field-scale research experiment) and passive (e.g., phased or incremental project implementation with monitoring to assess system response) elements of adaptive management. Also included is the concept of ecosystem thresholds, with "management options matrices" being developed to help guide management decisions on how best to proceed with restoration actions. The processes and framework developed in the Everglades may be helpful to other restoration programs that endeavor to incorporate adaptive management principles into their program.

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Addressing Sea Level Rise Impacts on Tidal Wetland Restoration Projects: The Development of NOAA Design Guidance and Potential Applications

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Tidal wetlands provide many ecological and human benefits to their surrounding area. They act as habitat for fish, shellfish, birds and other wildlife, provide protection from flooding and storm surges, and offer recreational and educational opportunities. The NOAA Restoration Center has been active for many years in restoring tidal wetlands from historic degradation such as filling, diking and tidal restrictions, but climate change, and sea level rise in particular, pose new threats that should be incorporated into restoration planning. In order to address sea level rise impacts on tidal wetland restoration in the Northeast region, NOAA convened a regional workshop of science and restoration experts in September 2010 to review the state of the science and discuss a white paper on this topic. Input from the workshop participants and reviewers helped shape a draft technical guidance document that provides a framework for NOAA Restoration Center staff and partners to assess, respond and incorporate the impacts of sea level rise on tidal wetland restoration projects in the Northeast Region into site-specific tidal wetland restoration planning and design.

The guidance centers around a five step planning process that is to be used during the feasibility, design and monitoring phases of a project. This process begins with predicting the relative sea level rise at the project site over a 50 year time period, using the Army Corps of Engineers multiple scenario approach. The second step is to gather relevant background information on the project site, including current elevations of the site, vegetation, tides and critical infrastructure, as well as determining the presence of any barriers to wetland migration. The third step is to conduct an analysis of the potential ecological, infrastructure and flooding impacts of sea level rise on the project under each of the three scenarios. This may involve a variety of modeling techniques, but the level of analysis should scale with the size and scope of the project. Next, project managers should use the results of the impact analysis to create or modify the project design, in order to maximize ecological benefits while minimizing risks. Finally, a project maintenance and monitoring plan should be developed that would allow for the evaluation of the success of the project over time and incorporate adaptive management since the magnitude of future sea level rise impacts is uncertain and varies across geographic regions.

The NOAA Restoration Center and its partners are currently evaluating several representative projects that would apply this guidance. These projects would evaluate the feasibility, applicability of the process, time, cost and level of expertise required to implement the guidance.

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The River of Grass Paradigm: Everglades Restoration Planning through Model-Assisted, Interactive Public Engagement

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Limited progress on Everglades restoration since 2000 suggests that resolution of the conflicting water needs of South Florida's urban, agricultural, and natural ecosystem stakeholders may be overly challenging for traditional planning processes. Recently, the opportunity to purchase extensive former Everglades land led the South Florida Water Management District (SFWMD) to initiate an ambitious, staff-intensive planning effort. The "River of Grass" (ROG) effort revolved around hands-on, public design of hydrological restoration scenarios. Design elements included water storage, water treatment, recreation, and agriculture. The geographic scope was expanded beyond the proposed purchase, to include Lake Okeechobee, the Everglades, and two estuarine systems receiving increased discharges from Lake Okeechobee. A multi-agency science meeting helped chart the initial SFWMD course. During 2009 and 2010, fifteen public workshops were organized to deliberately empower participants to interactively design "configurations" that would achieve their objectives as well as restore the Everglades. Participants were encouraged to form stakeholder groups, each entitled to present a configuration. Early informational workshops gave way quickly to active stakeholder roundtables, each provided with computers, GIS systems, hardcopy maps, and roving SFWMD expert staff.

The SFWMD provided model support to the stakeholder teams using RESOPS, a model written by Wilcox and Neidrauer in Microsoft® Excel to simulate managed and unmanaged South Florida surface water hydrology. A one month time step allowed simulations spanning a 41-year weather dataset to complete in <1 sec. This in turn allowed optimization analyses using very large numbers of runs, as well as rapid-response analysis of ideas and configurations proposed by stakeholders. Additionally, Wilcox and McVoy synthesized ideas from cross-agency Everglades hydrologists to create a set of "Everglades Viewing Windows," tools for intuitively visualizing Everglades hydrology as simulated by detailed regional hydrologic models. As model-independent tools, they allowed direct comparison of multiple models, in turn clearly showing the differences between the pre-development Everglades and the currently managed Everglades, as well as allowing comparisons of different restoration scenarios. RESOPS, the Everglades Viewing Windows, and additional staff evaluations ensured transparency and that stakeholders received rapid feedback.

Consistent stakeholder groups formed around all components: Lake Okeechobee, the estuaries, and the Everglades, submitting more than ten different configurations. All were evaluated by SFWMD staff; results presented back to stakeholders, and stakeholders given opportunity to revise and resubmit. From evaluation of the second submissions, SFWMD staff identified common elements. Further stakeholder design was then focussed on these elements. Successful project aspects included: sustained public engagement and enthusiasm, cross-stakeholder learning, emergence of cross-stakeholder synergies, converging positions, and increased agency credibility.

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HyperSpectral/LiDAR/RADAR Remote Sensed Imagery for Water Quality Monitoring and Environmental Impact Assessment in Ecosystem Restoration

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Today, most studies are based on very expensive and time consuming in-situ measuring/monitoring of the pollutant concentrations affecting the water body of the ecosystem. Remote sensing of natural resources has evolved into a highly specialized science with a demonstrated ability to detect or measure changes in watershed biomass as caused by natural sources and pollutant loadings. A multi-sensor approach can be applied to perform a characterization of the impact to the biomass of the ecosystem wetland vegetation by concentrating on the species responsible for most of the pollutant uptake.

Extensive research conducted in South Florida's Everglades shows that the shift from a diverse wetland plant community to a stand of Cattail has often been associated with changes in hydrology and nutrients. The literature indicates that the rising delivery rate of phosphorus to the northern Everglades, beginning in the 1950's, is considered to be the primary cause of increased biomass production due to the plan evasion on non-indigenous cattails (*Typha*) over native sawgrass (*Cladium*). Today, Cattails have replaced sawgrass throughout large section of the Everglades. Many ecosystem restoration efforts have been made to map Cattail from photogrammetry and color infrared aerial photogrammetry and from satellite imagery (Mostly SPOT and LANDSAT TM). Although these studies were mostly successful, the Cattail maps alone can not be used as a monitoring tool for phosphorus load reduction assessment. A 2003 LiDAR/HyperSpectral (HIS) imagery applied research project in South Florida indicated that LiDAR had the ability to obtain the biomass of Everglades Tree islands, and HIS had the ability to characterize the biomass by the structural components of the under story and tree-trunk vegetation. RADAR imagery can also differentiate the biomass of soft and hardwoods species.

A new effort has been proposed using HIS, LiDAR, RADAR and MS imagery for identifying not only the Cattail canopy but also by a chemical characterization of the cattail biomass as a function of the phosphorus nutrification process (Chlorophyll and Carotenoid Pigments from the chemotaxonomix assessment of periphyton mats through the Everglades ecosystem). The presence of Chlorophyll-a and its derivatives in an environmental sample indicates the presence of oxygenic photoautotroph such as occurring in the Cattail over-nutrification process. The accessory (-b, -c) Chlorophylls and the carotenoids provide additional biomarker specificity, and give information about the taxonomic structure and pigment distributions. The effort will be concentrated in identifying zones of less than 10ppb phosphorus concentration (the control group), and zones ranging from 10-30, 30-70, and 70-100 ppb phosphorus concentration. The goal is to create a cost-effective monitoring tool that will allow managers to assess the efficiency of proposed Stormwater Treatment Areas (STA's) or other Best Management Practices (BMP's) for ecosystem restoration projects.

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The Sustainability of a Tidal Salt Marsh Restoration Effort in Jamaica Bay, New York

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Jamaica Bay, located within the Boroughs of Brooklyn and Queens, New York City, covers 67.3 square kilometers and opens into the Atlantic Ocean via Rockaway Inlet. In the early 1900's, Jamaica Bay was an extensive estuarine ecosystem that sustained large expanses of tidal salt marsh. Over the last century, urban and industrial development has modified the natural environment surrounding the marsh islands through activities such as dredging and filling, construction, pollution, and over-harvesting or eradication of native plant and animal species. Based on aerial photography interpretation of Jamaica Bay, the New York State Department of Conservation (NYSDEC), estimated that approximately 567 hectares of tidal salt marsh have been lost since 1924, with the rate of loss rapidly increasing in recent years. At Elders Point between 1994 and 1999 an estimated 89 hectares of salt marsh were lost at a rate of 17.8 hectares per year. The mechanisms responsible for the observed losses have not been adequately accounted for but this multi-agency effort led by the U. S. Army Corps of Engineers (USACE) has begun to restore the salt marsh of Elders Point East. The project consisted of the placement of fill, regrading the site to appropriate elevations for the target community, and planting with native coastal plant species. A critical component of the success is the ability of the placed material to maintain design elevations for these ecologically significant salt marsh wetlands. Restoration efforts have included extensive monitoring to ensure worthwhile ecological goals have been provided and are a long term sustainable benefit to Jamaica Bay. Challenges that need to be overcome include compaction, subsidence, and erosion of placed material. The four years of survey data collected to date demonstrate that integrity of the approximately 17 hectares of created salt marsh wetlands are being maintained and project goals have been met.

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Louisiana Coastal Area- Restoration of the Maurepas Swamp

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Louisiana contains one of the largest expanses of coastal wetlands in the contiguous United States and accounts for 90 percent of the total coastal wetland loss occurring in the Nation. The natural processes of subsidence, habitat switching, and erosion of wetlands, combined with widespread human alteration, have increased rates of wetland loss and ecosystem degradation.

The Maurepas Swamp is the second largest continuous coastal forest in Louisiana, comprising over 190,000 acres of freshwater swamp habitat, and is experiencing similar wetland loss. The Maurepas Swamp is a valuable and unique ecosystem as it provides high value habitat for fish and wildlife including migratory birds and threatened/endangered species. The Maurepas Swamp serves as a buffer between the Lakes Maurepas and Pontchartrain and developed areas along the Interstate 10 (I-10)/Airline Highway corridor and also functions to provide an ecological barrier to prevent Gulf of Mexico influences. Being the largest swamp near the New Orleans metropolitan area this area has considerable cultural significance and is used for fishing, hunting, and other recreational activities. Without action, the Maurepas Swamp is expected to continue to deteriorate. The swamp would continue to be starved for land building sediment, freshwater and nutrients, which would prevent regrowth and prevent the swamp from keeping pace with subsidence. There would also be a decrease in habitat value to wildlife and fisheries. The swamp would transition from swamp toward marsh habitat and eventually open water. To preserve the swamp and its functions in the long-term, conditions must be reestablished that both allow survival of existing cypress and tupelo trees and increased recruitment and survival of seedlings. In the Maurepas Swamp, hydrologic connectivity, riverine influences, freshwater circulation, nutrients, and accretion are all needed for restoration.

The 2004 Louisiana Coastal Area Ecosystem Restoration Study and the 2005 Chief of Engineer's Report identified the Maurepas Swamp as a critical near-term restoration need in coastal Louisiana and recommended implementation of three projects: Small Diversion at Convent / Blind River, Amite River Diversion Canal Modification, and the Small Diversion at Hope Canal. The projects were aimed to: prevent future cypress swamp degradation and transition; restore the deltaic process impaired by levee and dredged material bank construction; and protect vital socioeconomic and public resources. Title VII of the Water Resources Development Act (WRDA) 2007 authorized the LCA program and the projects. The Small Diversion at Convent/Blind River and the Amite River Diversion Canal Modification projects have completed feasibility studies with a signed Chief of Engineer's Report and are beginning the Pre-construction Engineering and Design. The Small Diversion at Hope Canal has not yet begun under the LCA program however studies and preliminary design are being conducted under the Coastal Wetlands Planning, Protection and Restoration Act Program.

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Restoration Policy: A City Council Perspective

Kenneth S. Mierzwa

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As a City Council member and a consultant specializing in endangered species habitat restoration, I'm able to view restoration efforts from two very different perspectives. Scientists and land managers sometimes find it difficult to convey complex technical knowledge to the public and the media. Policy makers are usually not trained to analyze comprehensive datasets. Yet if we wish to push projects through a maze of funding constraints and regulatory hurdles and build restoration projects, these are all necessary skills. Someone needs to bridge the gap. Here, I'll attempt to describe the viewpoint of a small town elected official.

Habitat restoration opportunities typically come before a City Council in the form of mitigation required for infrastructure or development projects, or as "pure" restoration opportunities related to local or regional open space initiatives. Decisions are rarely based only on science. Elected bodies are driven by political philosophies, constituencies, and above all, the realities of managing limited financial resources in difficult economic times. A handful of constituents may attend meetings and express strong opinions which may or may not reflect the viewpoint of the community as a whole. There is no substitute for spending time on Main Street, and listening.

A Council is more likely to back a restoration project if cost is reasonable or the money comes from another source, and if there is perceived local benefit (tourism draw, mitigation for an infrastructure project). The local business community can be an advocate; birdwatchers at a local wetland restoration often stop on Main Street for lunch and stay in a local hotel. With complex and longer-term projects, continuity can be an issue. Most local elected officials serve two or four year terms, and election day can bring a profound change in direction. Often a project moves forward only if a Council or staff member or a member of the community takes the lead. This person serves as a go-between, translating the jargon of design engineers and regulatory agencies into language that elected officials, journalists, and voters are able to understand.

Regulatory requirements pose an especially difficult challenge. Tough rules intended to protect resources typically make no provision for restoration activities and increase costs. Despite these challenges, many restoration projects are completed successfully. There is considerable support among elected officials and constituencies in some municipalities, based on desires for improved quality of life, perceived economic benefits, linkages with other local projects, or simply personal interest. Understanding what drives local support (or opposition) and building coalitions of stakeholders including local elected officials, local staff, landowners, the business community, academia, and others can greatly increase the probability of success.

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Planning for the Impact of Climate Change for FEMA's National Flood Insurance Program

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To achieve usable results for a large-scale, multi-faceted climate change planning study, an important factor is to ensure that the source data will support a defined study approach that leads to quantifiable results. Selection of the data types and content that will be utilized as the basis for the study must be coordinated with the establishment of the methodology, equations, and/or models that will be used to process and analyze the data. In this presentation, a specific Federal Emergency Management Agency (FEMA) initiative will be used as an example of how data source selection influenced the development of an approach that produced usable, quantifiable results for future flood reduction planning and risk assessments.

The goal of this particular FEMA initiative was to quantify how the 100-year flood (floods having a 1% chance of exceedance) may change based on climate change and population projections through the year 2100. The study relied on data from the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report and the many Global Climate Models (GCMs) that contributed to the findings in that report. The downscaling of the GCMs was accomplished via a statistical procedure coupling some of the IPCC's extreme climate indicators (ECIs) with linear regression and Monte Carlo sampling. Regression analysis was used to identify major physiographic regions of the United States, relating watershed characteristics such as drainage area, slope, and impervious area, as well as observed extremes in climate, to the current 100-year flood. The observed relationships were then used within a Monte Carlo sampling framework to determine how climate change and population growth might impact flood discharges over the next 100-years. Magnitudes of projected changes in flood events were coupled with hydraulic data for the sample watersheds to develop estimates of the future floodplain extent for each watershed.

The results of this study show regional projections of changes to the future 100-year flood magnitude and the associated changes in the 100-year floodplain for affected populations across the U.S. The results will be used by FEMA determine the economic risks associated with climate and land use change on the U.S. National Flood Insurance Program. This information is paramount to regulators, practitioners, and local officials as they develop and implement sustainable, long-term solutions that will address climate-change related impacts.

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Environmental Restoration on the Upper Mississippi River System: USACE/Contractor Relationship in Ecosystem Planning and Restoration

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The Upper Mississippi River Restoration - Environmental Management Program (EMP) was authorized in 1986 and is recognized as the first major effort to restore the vitality of the Upper Mississippi River System's (UMRS) diverse and significant ecosystem. In filling this role, it became the first major effort in the nation to address large river restoration and scientific monitoring issues.

During the past 25 years the program has completed 53 projects that were designed to improve more than 94,000 acres of aquatic and floodplain habitat. There are currently 23 additional projects under design or construction, which will result in an additional 45,000 acres of restored habitat. In order to maximize the benefits from future projects, the U.S. Army Corps of Engineers, Rock Island District and Stanley Consultants have revisited projects from the past to assess their effectiveness. The current conditions were compared with the goals described in the original planning and design documents. The evaluation included physical, biological and managerial considerations.

The presenters will discuss past efforts and successes of the EMP and how assessing the effectiveness of past projects influences approach to future projects on the Upper Mississippi River.

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Defining the Spatial and Temporal Extent of Ecosystem Restoration Project Environmental Benefits

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The restoration project “footprint” in many cases does not adequately account for off-site influences that may impact or be influenced by restoration activities. As a result, environmental benefits ascribed to ecosystem restoration projects may be underestimated when assessed only within the boundaries of the project, as dictated by current Corps policy. This assessment could potentially lead to a lesser priority being assigned to specific projects or reduced overall benefits credited to the Corps’ Ecosystem Restoration Program as a whole.

This presentation will summarize the literature concerning physical boundaries of restoration benefits, the timeframe over which restoration is implemented and benefits are measureable, and potential interactions and tradeoffs that often emerge. Reversibility or persistence of both degradation resulting from environmental stressors and of restoration activities themselves are fundamental concepts that should be explicitly considered in formulating and evaluating ecosystem restoration projects. The importance of a reference framework against which benefits are assessed will be discussed, including appropriate assessment of benefits at comparable temporal and spatial scales applied to project sites. The authors investigate adapting the United Nations Millennium Ecosystem Assessment (MA) approach as an organizing for restoration to assess function and condition values of restoration. This internationally recognized approach may be tailored to allow assessment of ecosystem conditions and functions to a level that provides decision makers with aggregated sets of values that allow comparison of tradeoffs between project options, and evaluation and ranking of projects through the program scale. To create a clear framework for decision makers, an environmental benefits matrix could be created to show local to global scale, short- to long-term, and reversible to irreversible changes.

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Stability Thresholds and Performance Standards for Flexible Lining Materials in Channel and Slope Restoration Applications

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Selecting the right stabilization materials for use in stream channel or slope restoration is critical, but is complicated by the limited availability of comprehensive performance criteria, an increasing number of new materials and limited information regarding installation methods. Performance criteria for channel stabilization materials have traditionally focused on hydraulic parameters such as shear stress and velocity, but field performance of these materials is also dependent on non-hydraulic factors. Material selection, design, construction and installation procedures are all critical to project success. This presentation will summarize supplemental guidance to that provided in ERDC TN-EMRRP-SR-29, "Stability Thresholds for Stream Restoration Materials" (Fischenich 2001) which focused on hydraulic performance data for a variety of materials and a six-step materials selection procedure. This supplement focuses on flexible channel lining materials, though also provides additional information for a variety of slope stabilization methods and materials. An overview of selected design and installation criteria is provided, including critical materials properties, regional or climatic conditions, specific project applications, environmental considerations, discussion of project failure mechanisms, and generalized operations and maintenance requirements. Recommendations for product selection and field installation and monitoring are summarized.

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Reduction of Cattail Expansion in the Everglades: A Performance Measure Application

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A major challenge in large-scale ecosystem restoration projects is the selection of appropriate performance measures (PMs), and how to apply them in the calculation of habitat units, the primary output used by the Corps of Engineers in evaluating cost-effectiveness of alternative plans. Due to the intricacies of natural systems, the ecological response of proposed structural or non-structural measures is dependent upon simplifying assumptions, which are necessary to create an effective and efficient environmental benefit evaluation process. Broward County Water Preserve Areas (BCWPA), a large-scale ecosystem restoration project, is part of the Comprehensive Everglades Restoration Plan (CERP). The BCWPA project used three spatially discrete PMs to gauge its success and calculate the potential for ecosystem restoration. One PM calculated the reduction in the rate of cattail expansion, and the total acreage of expected cattail growth, partially based on the existing soil phosphorous concentrations and expected decreases in phosphorus loading.

Cattail (*Typha* spp.) is considered an invasive species in the Everglades, and has a negative impact on natural ecosystems. Elevated soil phosphorous concentrations promote rapid cattail growth. A primary goal of the BCWPA project is to improve marsh / ridge and slough habitat, which is partially accomplished through a reduction in the cattail expansion rate and total future acreage. BCWPA project construction features work together to retain clean water in the Everglades and reduce pumping of phosphorous-rich runoff from urbanized areas into the adjacent Water Conservation Area 3 (WCA 3). The connection between reduced pumping to WCA 3 and reduction in cattail expansion was determined by equations based on observed patterns of cattail expansion and related water quality and soil nutrient properties.

The BCWPA project demonstrates how even in a large-scale application, a straightforward ecosystem analysis based solely on changes in hydrology or water flows and associated nutrient loads is possible. Using this project as an example will hopefully allow others working on ecosystem restoration planning at any scale to see the “bigger picture”.

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Fast Tracked and Low Impact Repairs to Levees and Shoreline, Houston-Galveston Navigation Channel

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The Houston-Galveston Navigation Channel Shoreline Protection and Levee Repairs Project was performed in response to damages caused by Hurricane Ike to several key placement areas for dredged materials along the navigation channel of our nation's second largest port. The fast tracked design and construction of levee repairs, incremental levee raisings, and shore protection repairs was critical in order to allow for the continued maintenance of the channel, use of regional sediment placement areas, and the prevention of environmental impacts due to sudden loss and impairment of dredge material placement areas.

The Houston-Galveston Navigation Channel is within Galveston Bay, one of the world's most productive estuary systems. The design and maintenance of the ship channel in Galveston Bay is accomplished under an agreement with the resource agencies on the location, size, and design of the material placement areas to minimize and mitigate adverse ecological impacts resulting from deepening and later maintenance of the navigation channel. The levee repairs and shoreline protection completed during the project execution demonstrate how emergency construction work can be accomplished with minimum disruption to valuable habitat.

Overall, this project involved the handling and placement of approximately 4 million cubic yards of soil and 200,000 tons of stone. An innovative approach applied to this project at one of the water-accessible sites was the use of on-site materials rather than depending on import fill. In lieu of importing material from land using barges, the team created a temporary breach in the levee and mobilized dredges into the placement area. After removing overburden materials, native clay was mined and placed to construct the levees. Not only did this approach expedite the schedule, additional capacity in the placement area was created for future maintenance operations in the channel. Seven individual placement sites were addressed with over 21-miles of shoreline and levees. The sites included four islands with documented bird nesting areas, one oyster reef and a beneficial use area consisting of a valued interior marsh area. Through coordination with regional biologists and resource agencies and monitoring and avoiding sensitive areas, the project was able to meet necessary deadlines and project objectives with no adverse impacts to the local wildlife populations. In addition, sensitive and important vegetation on the shorelines and levees were protected when possible to provide storm water pollution and sediment/erosion control for Galveston Bay during, and after, construction. Following construction, disturbed and improved areas were seeded to promote re-vegetation, create habitat and mitigate erosion.

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Fish and Floods – Where Trackhoes Hit the Mud in Puget Sound’s Stillaguamish Estuary

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Puget Sound’s rich ecological and cultural heritage comes together in the deltas and estuaries of its major rivers. The Port Susan Bay Estuary Restoration Project is underway to reintroduce the full tidal prism and inundation regime to 150 acres of diked farmland in the Puget Sound’s Stillaguamish River estuary. In doing this, self sustaining native tidal-wetlands that support estuarine-dependent animals will be restored, juvenile salmon will gain improved access to restored rearing habitats, and connectivity will be increased between the river and tidal habitats in the northeastern portion of Port Susan Bay. This project will restore estuary-scale sediment and freshwater distribution, and is therefore critical to improving the resilience of the broader ecosystem to sea level rise. Further, this project will address a major community flood challenge, allow for greater public access to the site, and improve the ability of fish caught in flood waters to return to the natural system.

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Forecasting Fish Response to Habitat Features in Developing Riparian Project Design Alternatives and Supporting Long-Term Planning for the Sacramento River System

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The Sacramento River Bank Protection Project was authorized to protect more than 1700 kilometers of levees and flood control facilities. A key component of the levee repair work is the incorporation of environmental features that restore riparian and fish habitat function. Presently, the primary tool for planning the incorporation of these features is the Standard Assessment Methodology (SAM). SAM uses a combination of field data, riparian and geomorphologic models to assess proposed project impacts and benefits, but there still remains uncertainty regarding the function and value of the incorporated features for benefiting the target fish species.

To improve the assessment ability of SAM and better understand the benefits of the constructed habitat features and alternative planning objectives, we are collecting two-dimensional fish movement data using acoustic tags and developing models supporting the use of Eulerian Lagrangian Agent Method (ELAM). The ELAM extends the use of computational fluid dynamics models because virtual fish are released inside the model field where they can react to habitat alterations such as levee repairs or restoration actions. The fish movement tracking data is used to calibrate and validate ELAM output, which can be used to model generalized results to produce site-specific habitat suitability curves that can be incorporated into the SAM and improve assessment and forecasting capabilities. The combination of the SAM with ELAM is a promising approach that could improve the planning and execution of ecological restoration projects.

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Improving Hazardous Waste Site Remediation and Restoration Decisions Using Ecosystem Services

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Hazardous site management in the US includes remediation of contaminated environmental media and restoration of injured natural resources. Site remediation decisions are informed by ecological risk assessment (ERA), while restoration and compensation decisions are informed by the natural resource damage assessment process (NRDA). The focus of ERA is to determine the risk to ecological receptors posed by chemical and physical stressors at the site and, ultimately, to inform clean-up decisions. In the NRDA process, natural resource trustees quantify the magnitude of injury (impact) sustained by natural resources and the services they provide due to the release of oil or hazardous substances. Then, restoration actions are scaled to compensate the public for lost services. ERA and NRDA have been conducted largely independently of one another, often considering different ecological receptors and different scales of biological organization. As a result, the information provided to decision makers to inform remediation and restoration decisions typically lacks coherence.

The effectiveness of hazardous waste site management can be enhanced by focusing ERA and NRDA activities on common ecological assessment endpoints. Further, the value of assessment results to decision making can be improved by using ecosystem services as assessment endpoints. Ecosystem services are the outputs of ecological functions or processes that directly or indirectly contribute to social welfare or have the potential to do so in the future. The benefits of a shared focus on ecosystem service assessment endpoints by ERA and NRDA include greater coherence in the information provided to the remediation and restoration decision making processes, enhanced societal relevance of that information, and greater transparency of remediation and restoration decisions to the public. Building on earlier efforts by the U.S. Environmental Protection Agency, we encourage development of a suite of generic ecosystem service assessment endpoints (GESAEs) for consideration in hazardous site investigations. GESAEs are broadly described ecosystem service endpoints (e.g., production of recreational fish populations) that can be applicable in a variety of environmental management contexts. After consideration of their individual relevance, GESAEs can be tailored to the decision support needs of any particular hazardous waste site. Coordinated consideration of GESAEs in the problem formulation activities of ERA and NRDA will help to achieve risk reduction and restoration goals.

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A Past River for a Future Arizona – Salt River Environmental Restoration Project: Rio Salado Oeste Reach

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The Salt River once flowed perennially through the Phoenix area of southern Arizona, USA, supported a substantial amount of riparian vegetation (e.g., cottonwoods, willows, and mesquites), and enabled early Native American irrigation projects. As the Phoenix area developed in the 20th century, the construction of dams and appropriation of surface and groundwater transformed the Salt River into a “dry” river that flows only ephemerally in response to storm runoff and effluent discharge. Urban encroachment, grading, road construction, sand and gravel mining, and waste disposal have further degraded the river and altered the natural stream morphology and diversity of the natural riparian plant species. The Rio Salado Oeste (RSO) Environmental Restoration Project, implemented by the U.S. Army Corps of Engineers and the city of Phoenix, will restore natural ecosystem function to an 8-mile reach of the Salt River corridor and re-establish natural river morphology, hydrology, and riparian vegetation. After completion, the RSO project will enhance the local ecosystem with the addition of more than 1,000 acres of native riparian vegetation and more than 100 acres of new wetland, as well as restore sand and gravel mining pits within the floodplain. The project will create a sustainable natural habitat with a reliable water source from urban runoff and treated wastewater. Additional project benefits include control of flood flows and associated damages, improved water quality, an aesthetic and recreational amenity to the community, and improved property values.

Channel restoration will recreate, through grading and excavation, a stream morphology and floodplain that mimics historical conditions and similar natural riparian ecosystems in central and southern Arizona. A restored channel with “natural” sinuosity, geometry, and capacity will form the backbone of the RSO project and ensure hydrologic and habitat continuity for the wetlands and adjacent cottonwood, willow and mesquite habitat. The restored channel will link upstream and downstream river reaches, transport low flows to adjacent habitats, convey flood flows, and reduce flood elevations on adjacent terraces and floodplains.

The presentation will provide an overview of the RSO Environmental Restoration Project, including a summary of project history and benefits. The presentation will also review the analysis and design details of the channel restoration.

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Preliminary Results from the Schooner Bank Core, Everglades National Park, Florida

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The South Florida ecosystem has received national attention following the passage of the 1994 Everglades Forever Act, which mandates the return of the Everglades to its "natural state" with restoration efforts being governed by the Comprehensive Everglades Restoration Plan (www.evergladesplan.org). One goal of the U.S. Geological Survey (USGS) research on the history of South Florida's estuaries is to determine the nature and timing of changes to the South Florida ecosystem. Changes in the aquatic environment, whether natural or anthropogenic, alter the biological makeup of an ecosystem. Reconstruction of paleo-environmental conditions is possible by analyzing the distribution and abundance of organisms preserved in sediment cores.

As part of this research, shallow sediment cores have been taken in many locations throughout Florida Bay and the surrounding margins of the southern Everglades. Core GLBW299 SB1 was collected from the eastern side of Schooner Bank, which is located in the middle of a line of shallow banks that form the western margin of Florida Bay and the Gulf of Mexico (N 24° 58' 16.04", W 80° 58' 28.35").

Preliminary analyses of the faunal assemblages from the Schooner Bank core GLBW299 SB1 collected in February 1999 indicate Schooner Bank has been an outer estuarine environment for many centuries. Polyhaline to euhaline species appear consistently throughout the core from top to bottom, with no obligate marine assemblages present. ¹⁴C dating suggests the bottom interval (136-138cm) of core GLBW299 SB1 dates to ~4,500YBP. Analyses are being conducted to examine (1) faunal changes in the mollusks, (2) ²¹⁰Pb analysis, and (3) floral changes in the pollen assemblages. Faunal assemblage analyses provide information on the salinity and benthic habitat at the core site, ²¹⁰Pb data yields information about the sedimentation rates and age of the core interval and floral assemblage analysis produces data about the proximal terrestrial environment. In addition the first occurrence of pollen from the Australian pine, *Casuarina equisetifolia*, serves as a biostratigraphic marker for the beginning of the 20th century.

The Schooner Bank core provides information on the long term environment along the western margin/ Gulf transition zone of Florida Bay. These preliminary results contrast with our cores from the northern (Murray, and others, 2010) and central (Wingard, and others, 2001) zones of Florida Bay that illustrate significant environmental changes during the period (0-4,500YBP) of sediment deposition.

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Potential Climate Change Impacts on the Chesapeake Bay

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We review current understanding of the potential impact of climate change on the Chesapeake Bay. Scenarios for carbon dioxide emissions indicate that by the end of the 21st century the Bay region will experience significant changes in climate forcings with respect to historic conditions, including increases in carbon dioxide concentrations, sea level, and water temperature of 50-160 percent, 0.7-1.6 m, and 2-6 K, respectively. Also likely are increases in precipitation amount (particularly in the winter and spring), precipitation intensity, intensity of tropical and extratropical cyclones (though their frequency may decrease), and sea-level variability. The greatest uncertainty is associated with changes in annual streamflow, though it is likely that winter and spring flows will increase. Climate change alone will cause the Bay to function very differently in the future. Likely changes include: (1) an increase in coastal flooding and submergence of estuarine wetlands; (2) an increase in salinity variability on many time scales; (3) an increase in harmful algae; (4) an increase in hypoxia; (5) a reduction of eelgrass, the dominant submerged aquatic vegetation in the Bay; and (6) altered interactions among trophic levels, with warm-water fish and shellfish species ultimately being favored in the Bay. The magnitude of these changes is sensitive to the carbon dioxide emission trajectory, so that actions taken now to reduce carbon dioxide emissions will reduce climate impacts on the Bay. Research needs include improved precipitation and streamflow projections for the Bay watershed and whole-system monitoring and modeling (supplemented by process studies) that can capture the likely non-linear responses of the Chesapeake Bay system to climate variability and change.

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Development of the Natural Resource Baseline Assessment for the Missouri River Ecosystem Restoration Plan

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The effort to develop the Missouri River Ecosystem Restoration Plan (MRERP) was launched in 2007 with authorization from Congress to develop a plan for the 2500 mile-long Missouri River and its tributaries to “mitigate for lost habitats; recover federally listed species; and restore the ecosystem to prevent further declines of native species.” To date, 32 Cooperating Agencies, 29 tribes, a 70-member stakeholder committee, 65 member basin-wide technical team, and the lead agencies (USACE and USFWS) have collaboratively established the broad study purpose, need and goals, and completed preliminary evaluations of the current conditions of Focal Natural Resources (native river ecosystems and their associated habitats and species). The current condition evaluation of Focal Natural Resources has included identification of Key Ecological Attributes (the critical processes and conditions required to sustain the ecosystems and their components – e.g., river flows, sediment, water quality), selection of a set of indicators appropriate for regional-scale assessment of the Key Ecological Attributes, and evaluation of the current status of the indicators. The product of this effort is a scorecard of the current status of Key Ecological Attributes within each of the focal natural resource ecosystems. This evaluation will inform numerous future planning steps, including the development of restoration, mitigation and recovery objectives, formulation of alternatives, assessment of the impacts of alternatives, and the development of an adaptive management plan.

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Reference Condition Approach to Large River Restoration Planning

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Ecosystem restoration planning requires quantitative rigor to evaluate alternatives, define end states, report progress, and perform environmental benefits analysis. Unfortunately, existing planning frameworks are, at best, semi-quantitative. The Upper Mississippi River System (UMRS), like many large restoration sites, requires a quantitative framework using precisely defined terms that can be used to organize potential management actions into a scientifically defensible, internally consistent, strategic implementation plan. Such an organizing framework assures restoration goals and objectives can be effectively achieved within the general framework of adaptive environmental assessment and management. In this presentation, we: 1) describe a quantitative restoration planning approach based on a comprehensive, but simple mathematical framework that can be used to effectively apply knowledge and evaluate alternatives, 2) use the approach to derive a simple but precisely defined lexicon based on the reference condition concept and allied terms, and 3) illustrate the approach with an example from the UMRS using hydrologic indicators.

The approach supports the development of a scalable restoration strategy that, in theory, can be expanded to ecosystem characteristics such as hydraulics, geomorphology, habitat, and biodiversity. We identify three reference condition types, Best Achievable Condition, Measured Magnitude (which can be determined at one or many times and places), and Desired Future Condition that, when used with the mathematical framework, provide a complete system of accounts useful for goal-oriented system-level management and restoration. The approach appears scalable from relatively local to global scales so long as defensible descriptions of the Best Achievable Condition and Desired Future Condition are available and a consistent set of evaluation variables is employed. We encourage others to test and refine these methods for application to other restoration programs as part of development of quantitative tools for ecosystem management and restoration planning.

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The River Machine: A Conceptual Model for Large Rivers Integrating Fish Movement and Habitat, Fluvial Geomorphology, Fluid Dynamics, and Biogeochemical Cycling

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The dynamics of many large floodplain rivers are dominated by the flood pulse. The high energy flows associated with the flood pulse form and reform the river channel. In general, the flood pulse supports the immense abundance and diversity of river life by transporting nutrients and organic matter into backwaters in spring, supporting primary and secondary production during the summer, and redistributing these products to channels as water levels recede. Both North American and South American fluvial dependent large river fishes exhibit complex, system-level longitudinal and/or lateral movements across life stages that allow them to exploit flood pulse driven spatial heterogeneity and seasonal connectivity to feed, reproduce, and avoid harsh conditions. We argue that two hydraulic variables, the magnitudes of velocity and the spatial velocity gradient, are necessary and sufficient to both understand fish “hydro-navigation” as well as explain patterns in biogeochemistry and fluvial geomorphology and thereby create a new conceptual framework for large flood plain rivers integrating fluid dynamics, channel morphology, biogeochemical cycling, and important elements of fish ecology. We illustrate the framework using summary data from the São Francisco River, Brazil that contains sub basins possessing different levels of impact. We believe the framework is an important element of large river restoration because it directly links the unique physical and chemical processes of large floodplain rivers to life requirements of fishes and other biota. Therefore, this framework should be an important element of restoration planning for large rivers and other systems in which biotic response to management action can be linked to cyclic patterns of geomorphology, fluid dynamics, and biogeochemistry.

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The Effects of Riparian Ecosystem Processes on Water Quality: Nutrient Mineralization and Budgeting in the Difficult Run Floodplain Study

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Previous research has documented large rates of sediment and associated phosphorus (P) and nitrogen (N) accumulation in the floodplains of Coastal Plain rivers of the Chesapeake Bay watershed equivalent to large proportions of the annual river load. However, the magnitude of this important ecosystem service is not known for urban watersheds or for the Piedmont physiographic province where sediment yields are the highest in the Chesapeake Bay watershed. In addition, the source and permanence of material being deposited on floodplains must be identified to fully budget the role of floodplains in improving stream water quality. The goal of the Difficult Run Floodplain Study is to quantify the sediment and nutrient retention functions of riparian floodplains in a developed Piedmont watershed of the Chesapeake Bay. We are measuring sediment and nutrient accumulation, erosion, and cycling processes to better understand the role of riparian ecosystems in retaining stream loads. Here we report measurements of *in situ* soil mineralization of N and P (the conversion of organic to inorganic forms) to identify the biogeochemical permanence of nutrients accumulating and stored in floodplain soils. Twelve sequential monthly incubations of modified resin cores were performed at 28 plots arrayed longitudinally among 5 sites located from the headwaters to the mouth of the watershed and laterally among the levee, backswamp, and toe-slope geomorphic zones of each site. Annual P mineralization differed among geomorphic locations as well as among sites depending on seasonality, and increased with greater soil acidity and gravimetric moisture content. Annual N mineralization differed among geomorphic locations, and increased with greater soil organic content, soil P and acidity, herbaceous plant production, and soil wetness. The annual amount of nutrient mineralized relative to the amount of nutrient present in the soil corresponds to turnover rates of 23 years for N and 383 years for P. Both N and P mineralization rates were stimulated by deposition of fresh sediment during flood events, although the amount mineralized was far less than the amount of N and P deposited. In addition, N but not P mineralization was positively related to vegetative uptake of N and P, but again mineralization was less than plant uptake. The results were used to budget N and P cycling in the floodplains. We found that the floodplains of Difficult Run trap large amounts of sediment and that deposited N and P are tightly cycled within the floodplain, indicating long-term retention of sediment, N, and P, corresponding to meaningful improvement in water quality. Floodplains, including those in the Piedmont physiographic province, are important sinks for sediment and nutrient loads that create long lag times between upland erosion and downstream delivery in stream corridors.

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Integration of Existing EPA Authorities and New Restoration Efforts to Accelerate Recovery of Areas of Concern in the Great Lakes Basin

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The Great Lakes Water Quality Agreement, signed by the United States and Canada in 1972 and later revised in 1978 and 1987, identified 43 “pollution hotspots” or Areas of Concern (AOC) in the Great Lakes basin. AOCs are typically associated with urban areas at the interface of rivers and the Great Lakes. As a result, AOCs are impaired due to numerous interacting and complex factors including release of toxic substances, physical alteration of habitats, increased nutrient delivery to rivers, and municipal discharges. These sources of impairment have resulted in the loss of multiple beneficial uses within AOCs such as fish and wildlife consumption, water consumption, loss of fish and wildlife habitat, recreational activities, and aesthetics. Eight U.S. states, the Province of Ontario, and U.S./Canadian agencies have been and continue to be dedicated to addressing these impairments and restoring beneficial uses within AOCs through the use of federal, state, and local environmental programs and consultation with local citizen groups.

On the U.S. side of the Great Lakes, the U.S. Environmental Protection Agency (EPA) is the lead federal agency tasked to restore AOCs and delist beneficial use impairments. Up to 2010, the EPA and its partners have relied on a variety of statutory authorities to remove toxic substances commonly responsible for these impairments including the Comprehensive Environmental Response, Compensation, and Liability Act (i.e., Superfund) and the Great Lakes Legacy Act. Each authority has targeted removal of contaminated sediment in AOCs, both terrestrial (Superfund) and aquatic (Superfund and Legacy Act). The Great Lakes Restoration Initiative (GLRI) began in 2010, committing \$475 million to accelerate restoration of the Great Lakes basin including AOCs. The GLRI has provided enhanced resources to be focused on remaining sources of impairment within AOCs not typically addressed by existing authorities. The Sheboygan River AOC, located in Sheboygan, Wisconsin, represents one such AOC where coordination of Superfund, Legacy Act, and the GLRI is underway. This presentation details advantages, challenges, and considerations of integrating multiple federal programs to restore the Sheboygan River AOC. Development of sediment remediation projects and habitat restoration activities are highlighted to provide an example of complex restoration activities underway in the Great Lakes basin.

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Bathymetric Data and Aerial Photography Provide Insight into Five Decades of Lower Mississippi River Side Channel Change.

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In large rivers, side channels can provide a refuge offering moderate conditions compared to the main channel. In many multi-use rivers, management has reduced the occurrence of processes that create side channels. Existing side channels are in various stages from connected open water to backwater and unconnected wetland. The purpose of this study is to determine the changes that have occurred and status of Lower Mississippi River (LMR) side channels from 1960s to the 2000s. For this study, we defined side channels as: areas where the channel bed is less than + 10 low water reference plane (LWRP). This channel bed is separated from the main channel by a bar with a crest elevation $\geq +5$ ft LWRP. The side channel boundary is the crest of the bar and an imaginary line extending perpendicular from the ends of the bar across the channel to the top bank. The New Orleans, Vicksburg, and Memphis Districts, U.S. Army Corps of Engineers, provided one set of bathymetry data from each of five decades (1960s, 70s, 80s, 90s and 00s). We produced digital terrain models from each set of bathymetry data to recreate the river bottom. We used the digital terrain models to determine the presence, area and volume of each side channel for each decade. The bathymetry data provided an opportunity to observe the formation, movement and disappearance of sand bars and islands in the main channel. However, the bathymetric data rarely captured side channels formed from point bar cutoffs. Aerial photography was paired with the bathymetric data to provide information on island status and a more inclusive depiction of the number of side channels existing in the LMR. In the bathymetric data alone, we found 203 side channels over five decades in the LMR. However, only 22 had over 80% data coverage for all five decades. The bathymetry data indicates that the main channel of the LMR is very dynamic with side channel prevalence decreasing as you proceed down river. The aerial photography and bathymetric data can provide information on side channel condition, be used to measure project success, point out areas in need of restoration, and prioritize restoration projects.

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Improving an Urban Ecosystem for Recreational Uses: The Carpenter Lake Restoration Project

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The purpose of this project was to restore Carpenter Lake and provide a recreational connection to the ecological restoration. The Rouge River Watershed, in southeast Michigan, is considered the state's most urbanized watershed. As one of Southfield's largest community parks, Carpenter Lake Nature Preserve is a critical piece of city-owned open space and is one of only a limited number of Rouge River sites in Oakland County where public access is available. The project improved storm water management, public recreation uses and wildlife habitat.

In February, 2003, the City of Southfield acquired the 30-acre Carpenter Lake property as part of a land trade under the Federal Land for Parks program of the U.S. Department of Interior. The Carpenter Lake site represents virtually the only lake in Southfield and the only parkland and open space in the area where it is located.

Multiple objectives were served by this project. The project incorporated innovative storm water techniques and improved public recreation and wildlife habitat. The existing dam, which was undersized and breeched, was reconstructed to prevent failure. The lake and dam restoration vastly improved conditions by removing invasive fish and aquatic species and creating lake structural and ecological habitat to foster increased wildlife/fish populations. Over 30,000 cubic yards of sediment was removed to re-shape and provide depth to the lake. Wetland fringe areas and structural habitat were created to provide habitat for native fish and wildlife. An invasive fish removal program was conducted within the lake and upstream river portion to help establish a better native/sport fish population. The lake's storm water controls now also help control urban flood events which, in the past, had severely damaged downstream ecology. Finally, to tie the lake and the surrounding area together, a new 42-acre nature preserve with a trail system and interpretive signage was developed.

This project has improved the Rouge River Watershed by increasing recreational opportunities, addressing storm water management issues and improving fishery and wildlife habitat. Habitat improvements allow a place for plants and wildlife to thrive. As part of the dam structure replacement, flow variability and flooding is reduced through management of water before, during and after storm events which improves the quality of water downstream of the lake.

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Urban Ecosystem Bluff Restoration Project

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River flows of the Rouge River through the City of Dearborn, MI have increased in volume, peak flow and velocity. This has resulted in the development of severe erosion along the river banks in this area, including at the streambank adjacent to the parking lot at the Henry Ford Community College (HFCC). At this location, known as Kingfisher Bluff, there is a sharp bend in the Rouge River where the water velocity at this curve had resulted in an ongoing erosion problem on the outer bend, leaving a steep, unstable sandy face (approximately 30 feet high). Not only did the continued erosion of the Kingfisher Bluff and its contribution of sediments to the river negatively impacted the habitat/water quality, but it also was a significant safety hazard and jeopardized the stability of the adjacent edge of HFCC's parking lot.

This project was designed and constructed to reduce the impacts from the HFCC parking lot using best management practices for storm water management and to stabilize the stream bank at Kingfisher Bluff to eliminate this area as a source of excessive sediment to the Rouge River.

The project goals were:

- Design and implement innovative methods for retrofitting the HFCC parking lot to reduce the amount of runoff and improve the water quality of runoff.
- The stabilization of the existing eroding stream bank by means of cutting the slope back to a stable angle of repose and the use of vegetation. The existing slope is at a maximum slope of 1.25 Vertical, to 1.0 Horizontal. Based on the slope stability analysis, this slope yields a safety factor of 0.5. An acceptable safety factor for a permanent slope is 1.5. In order to obtain a stable slope, a slope of 2.5 Horizontal, to 1.0 Vertical is proposed.
- The incorporation of boulder and tree revetment toe stabilization treatments. This provides treatment as well as habitat.
- An at-grade educational overlook with a segmental block wall base.
- Creation of a link between the project site by a short spur to the Gateway Trail that will connect the Rouge Parkway and pass through the campuses to Michigan Avenue, and,
- Placement of interpretive signage at Kingfisher Bluff to inform visitors about the environmental educational aspects of this project.

This project stabilized the Kingfisher Bluff slope using soft engineering practices above the river line. This strategy allows for the stabilized stream bank to take on more of the natural characteristics of the surrounding areas. The bank has been covered with deep-rooted vegetation to control erosion and provide habitat and aesthetic benefits. Construction was completed in June 2009 and has showed the ability to withstand the scouring velocities of the river. Additionally, evidence of nesting has been observed in the nesting habitat that was established.

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Sulfate as a Contaminant in Freshwater Ecosystems – Sources, Impacts and Mitigation

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Most freshwater wetlands unimpacted by anthropogenic contaminants have low levels of sulfate in surface water, and as a result microbial sulfate reduction and biogeochemical cycling of sulfur are minor processes. The introduction of sulfate into wetlands from anthropogenic sources can significantly increase sulfate levels and rates of microbial sulfate reduction, with potential impacts including: toxicity to flora and fauna from sulfide, an end product of microbial sulfate reduction; increased biodegradation of organic matter and recycling of nutrients; changes in redox conditions; and altered metal solubilities and speciation through reactions with sulfide. Perhaps the most significant environmental effect of increased sulfate loading to freshwater wetlands is stimulation of methylmercury (MeHg) production by sulfate reducing bacteria. Bioaccumulation of neurotoxic MeHg in upper trophic level organisms is a serious environmental issue in many freshwater wetland ecosystems worldwide. In the freshwater Everglades, sulfate loading from canal discharge has resulted in sulfate concentrations up to 100 times background levels and this has stimulated MeHg production and bioaccumulation. Despite the detrimental impacts of high levels of sulfate in freshwater wetlands, there are no USEPA or State numeric water quality criteria to limit sulfate concentration in the context of ecosystem protection.

A comprehensive understanding of the sources of sulfate to freshwater wetlands is a key element to develop strategies to reduce sulfate loading and impacts. Major anthropogenic sources of sulfate include wet and dry deposition (especially acid precipitation), surface runoff from urban and agricultural sources, and pumping and release of high sulfate groundwater. A major source of atmospheric sulfur is emission of sulfur dioxide from coal-fired power plants. The sulfur dioxide that is emitted is oxidized to sulfate in the atmosphere and enters wetlands as sulfate in acid precipitation. Mitigation of sulfur dioxide emissions using scrubbers on power plant stacks has been effective in reducing these sulfur loadings over the last thirty years. Sulfate is also present in urban sewage and runoff from agricultural sources. Reduction of sulfate loading from sewage requires advanced water treatment. Sulfur is used ubiquitously in agriculture in fertilizers, soil amendments, and as a fungicide. Approaches to reduce sulfate loading from agricultural sources to freshwater wetlands includes the use of agricultural best management practices for sulfur use and additional mitigation strategies as needed. Both passive and active removal strategies for sulfate are available, but these suffer from a number of problems, most notably high cost. Biological sulfate mitigation in constructed wetlands appears to remove little sulfate from surface water unless the residence time of water in the wetland is very long. The most effective approach to reducing sulfate loads to freshwater wetlands will likely be multifaceted, involving reductions in sulfate sources, biological sequestration of sulfur, and passive removal processes.

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Seed Addition Facilitates Eelgrass (*Zostera marina* L.) Recovery in a Coastal Lagoon System (USA)

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The coastal lagoons of Virginia once supported vast meadows of the marine seagrass *Zostera marina* L. (eelgrass) along with a commercially viable bay scallop fishery until 1933 when eelgrass completely disappeared, along with the bay scallop fishery. These bays remained unvegetated until 1999 when a large scale restoration effort was initiated following initial success of adult plant test plots. Eleven years of eelgrass restoration using seeds conducted in this coastal lagoon system have resulted in a rapid rate of expansion of eelgrass beyond the initially seeded plots. These seed additions simulated massive seed recruitment events in areas where the relative isolation from the nearest seed-producing beds may have historically resulted in rare, low-density seedling recruitment. 38 million seeds have been added to these coastal bays over 11 years and has resulted in approximately 4200 acres of eelgrass now growing in four contiguous bays. Water quality conditions documented by seven years of spatially-intensive and continuously-monitored water quality data show excellent water quality that has allowed eelgrass to survive and spread rapidly. The development of these beds has influenced several of the key ecosystem services provided by eelgrass, namely improving water clarity and increased deposition of fine grained material. Recent efforts on re-introducing the bay scallop are being attempted and if successful may represent the first successful re-introduction of a commercial viable species that had been absent for almost 80 years. This eelgrass restoration effort may represent one of the most successful seagrass restoration programs today.

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An Adaptive Management Framework for Implementing the 2012 Update of Louisiana's Comprehensive Master Plan for a Sustainable Coast

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The 2012 update of *Integrated Ecosystem Restoration and Hurricane Protection: Louisiana's Comprehensive Master Plan (MP) for a Sustainable Coast* incorporates an Adaptive Management (AM) framework that leverages lessons learned from 20 years of restoration efforts in Louisiana and is responsive to the more recently evolving scientific and technical knowledge following the major hurricanes of 2005 and 2008. This programmatic framework allows for the LA Office of Coastal Protection and Restoration (OCPD) to be responsive at both the project and program levels as monitoring information provides information on project and program effectiveness.

This AM framework was developed by an interagency and interdisciplinary AM working group and built upon previous coastal Louisiana AM efforts and frameworks (e.g., CWPPRA Adaptive Management Review, 2002; LCA Science and Technology Office, 2004; LCA Adaptive Environmental Assessment and Management, 2004). It also incorporates elements and strategies detailed in other large restoration and/or protection programs (e.g., 2010 Comprehensive Everglades Restoration Plan Adaptive Management Integration Guide). A unique element of this AM framework is the explicit inclusion of coastal protection features (e.g., hurricane levees) in addition to coastal ecosystem restoration.

Challenges to instituting and applying such a framework include: the development of a governance structure; true integration of storm protection and coastal restoration features to ensure a balanced AM approach; cohesive retroactive application of an AM framework to projects that are already constructed or in progress under various authorities; development of procedures for reporting to decision-makers and stakeholders; and lastly, adjusting decisions and management actions as implementation of the MP progresses.

A follow-on activity to this initial effort is an expansion of the AM framework and governance structure to include other State agencies, stakeholders, and possibly Federal agencies as related to the entire Louisiana coastal restoration and protection program.

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Louisiana's Coastal Forest Conservation Initiative and the Spatial Decision Support System

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Under the Coastal Impact Assistance Program (CIAP) Louisiana has dedicated \$16M toward developing and implementing a Coastal Forest Conservation Initiative (CFCI). Coastal forests, in addition to habitat value, provide invaluable storm surge attenuation and serve as a critical line of defense to communities. The CFCI will purchase conservation easements or fee title to forested land from willing land owners throughout the 8,000 square miles of land in the coastal zone. This program implements land conservation as a tool in the overall restoration of coastal Louisiana, by conserving existing intact coastal forest before it is converted to non-forested use. To objectively facilitate the acquisition of these land rights, a Spatial Decision Support System (SDSS) was developed to assist the Louisiana Office of Coastal Protection and Restoration (OCPR) in prioritizing the areas to be acquired. This custom tool was developed in C# as an ArcGIS extension utilizing distance decay theory and Spatial Analyst functionality to create a prioritization surface for the conservation of forested lands across the coast. This spatial index will serve as one of the primary benchmarks for state acquisition of forested lands in coastal Louisiana. The CFCI will be the first coastal forest conservation program in the nation utilizing GIS as a core decision making and management tool. The CFCI Program will begin its first phase in 2010. This presentation will provide an overview of the program and its implementation, as well as discuss the use of the SDSS tool in prioritizing the first phase of land rights acquisition.

Louisiana is developing a Coastal Forest Conservation Initiative to purchase land rights to forested land for conservation. A Spatial Decision Support System (SDSS) was developed to assist in prioritizing areas. This presentation will provide an overview of the program and implementation, and discuss using the SDSS tool to prioritize acquisitions.

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Louisiana's Coastal Impact Assistance Program (CIAP) - Cutting Edge Projects, Implementation Challenges and Successes

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The State of Louisiana loses approximately 24 square miles of land per year, or the equivalent for a football field every 38 minutes. This land is converted to open water, creating one of the largest environmental crises facing our country. The land and habitat loss is due to a number of factors, including lack of freshwater and sediment input to surrounding marshes due to Mississippi River levees, land subsidence, sea level rise, salinity intrusion, erosion exacerbated by increased intensity of tropical storms, and the effects of canals built for navigation and oil/gas uses. Not only is this area essential habitat, but it is also critical to the area's heritage, culture, recreation, and way of life. Each American's daily way of life relies on coastal Louisiana for many reasons, yet it is disappearing at an unbelievable rate with each passing moment.

The State of Louisiana is currently implementing one of the country's largest coastal habitat restoration efforts. Louisiana's Coastal Impact Assistance Program (CIAP) provides approximately \$500M to coastal Louisiana over four years to implement over 100 coastal restoration and infrastructure projects. This funding alone more than doubles the historical annual expenditures of the Louisiana Office of Coastal Protection and Restoration and requires project implementation rates to double or triple. The State of Louisiana's CIAP restoration projects include freshwater diversions, shoreline protection, marsh creation (including both dedicated dredging as well as beneficial use of navigational dredged material), barrier island beach/dune restoration, coastal forest preservation, wetland assimilation of treated wastewater, and several studies/monitoring to further the science and approach of coastal restoration in Louisiana. Projects range in status from planning to construction, with some projects already completed. This presentation will cover CIAP background and the implementation of this high profile work, related program management, and highlight two of the cutting edge CIAP projects:

- One unprecedented project, the Mississippi River Long Distance Sediment Pipeline, is a proposed 20 to 30 mile pipeline to carry 50 million cubic yards of sediment over its lifetime in a slurry from the Mississippi River bed to create marsh and/or ridges
- Barataria Land Bridge Dedicated Dredging project - sediment was dredged from the nearby bayou and deposited the material within a contained area to create and nourish marshes

Not only can lessons from these efforts be applied to habitat restoration efforts across the country, but program management approaches can be applied to programs of various types nationwide.

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Biomass Estimation for Carbon Cycle of Brazil Biomes

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Studies are demonstrating the great importance of the Amazon Biome in the carbon cycle. This way, the biomass above the ground estimate is necessary to understand this productivity, nutrient allocation and carbon cycles. With the increasing interest for the CO₂ quota funding, these studies perform a primordial role in the area quantification and indirect estimate by means of equation models developed for each biome. World's largest biological diversity reserve, the Amazon Forest is also the largest Brazilian biome and occupies almost half of the national territory (49.29%). The Amazon basin occupies 2/5 of South America and 5% of the Earth's surface. Its area of approximately 6.5 million square meters, shelters the largest planet hydrographic net, which flows off almost 1/5 of Earth's fresh water volume. Sixty percent of the Amazon Basin is located in the Brazilian Territory, where the **Amazon Forest Biome** occupies the totality of five federation units (Acre, Amapá, Amazon, Pará and Roraima), a great part of Rondônia (98.8%), more than the half of Mato Grosso (54%), besides part of Maranhão (34%) and Tocantins (9%). The study proposed in this document has the objective of presenting the Brazilian Biomes and Biomass estimates. There are presented a revision on Biomass and estimates indexed by latitude and longitude regarding the Amazon Forest, as well as an analysis on the Atlantic Forest using available technological instruments, and thus aiming to contribute to the Brazilian environment managing. The Biomass estimation presented in this work was based on the data of the RADAMBRASIL Project (1973-1983), using Biomass equations. The existence of studies on reminiscent forest surveys has been considered, and with the inclusion of the RADAMBRASIL Project's (1973-1983) data, the Brazil's Biomass Chart (IBGE, 2004), the TM/Landsat 5 image analysis available at the scale 1:250.00, and the use of available allometric equations, allowed the elaboration of the presented graphics in compliance with the latitude and longitude.

Key Words: Biome, Biomass, Brazil, Amazon, Atlantic forest

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Natural Vulnerability of an Aquifer System in Brazil

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This research had as objective to map the natural vulnerability of the Guarani Aquifer System in at Santana do Livramento city in Rio Grande do Sul state, Brazil. For so much, for the execution of this research, it was used pre-existent data, field research and geo technologies. The methodology used for mapping the natural vulnerability was the DRASTIC Model. The registered sources of contamination were the gas stations, cemeteries and the old garbage deposit. We mapped three cemeteries, one old garbage deposit, as well as twenty-two gas stations. All located in areas of recharge of the Guarani Aquifer System, which represented risk of contamination. As verified more relevant result, we can stand out that the vulnerability classes of the area varied of vulnerable, very vulnerable and extremely vulnerable. This way, the importance of the administration of the underground hydrous resources is evidenced in the studied area. We expect that the information obtained and the applied methodologies in this work can subsidize actions addressed to the integrated administration of the hydrous resources, as well as in the occupation plans and use of the soils, in agreement with foreseen in the Statute of the Cities and in the Master Plans.

Key word: Natural vulnerability, Brazil, Guarani aquifer system, and Geo technologies

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Impact of Temporal Autocorrelation on Land Loss Modeling in the Coastal Louisiana Deltaic Plain

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The purpose of this study is to model land loss in the coastal Louisiana deltaic plain from 1984 to 2010, using a time series of 27 Landsat Thematic Mapper (TM) satellite images that were classified to identify land and water, and to investigate the autoregressive process to predict future land loss. Temporal autocorrelation of the data violates the main assumption of regression analyses, that observations are temporally independent, and thus non-autoregressive estimates will be biased and (or) inconsistent. Temporal autocorrelation is a measure of the similarity between observations as a function of time and helps in defining appropriate autoregressive integrated moving average (ARIMA) models for consistent forecasting. We also consider the influence of marsh vegetation community types (swamp, fresh, intermediate, brackish, and saline) on land-loss autocorrelations. Swamp and fresh marsh time-series data have no temporal autocorrelation and display seasonal and annual variability that appear independent of recent extreme storm events. Intermediate and brackish marsh time-series data behave very similarly, with a high temporal autocorrelation coefficient greater than 0.80 for the first time lag, and with a statistically significant residual autocorrelation greater than 0.60. These results indicate that simple regression models are not appropriate for these datasets. The time series for saline marsh displays a moderate autocorrelation coefficient (0.53) with a weak residual autocorrelation coefficient of 0.25 and a p-value of 0.05. The most recent extreme storm events severely impacted the intermediate, brackish, and saline marshes, but only the saline marsh showed current land-area levels comparable with the land area present in 2002 indicating recovery. The recent impacts of extreme storms in the delta plain influences previously calculated land-loss rates, and constrains the time range of reliable forecasting to about 10 years.

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Monitoring Oyster (*Crassostrea virginica*) Populations at Reef Habitat Restoration Sites in the St. Lucie and Loxahatchee River Estuaries

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Oyster reefs are vital to the health of an estuary because they effectively stabilize shorelines, provide habitat for numerous species, and improve water quality by filtering out nutrients and fine sediments. In Florida, oysters occur in nearly all estuarine and nearshore waters such as the St. Lucie and Loxahatchee River estuaries. Those waters, and other coastal waters in southeast Florida, have experienced altered patterns of water delivery and quality as a result of water management practices. In particular, the redirection of freshwater out of inland basins and into coastal waters has altered both the timing and range of salinity variation in those waters. In the St. Lucie estuary, large releases of freshwater laden with sediment and nutrients lead to muck accumulation and low salinities. In the Loxahatchee, reduced freshwater inflows and the permanent opening of the inlet have allowed oceanic waters to encroach into the estuary. As a result, oyster populations in both estuaries have significantly declined over the past 50 years.

In June 2009, the National Oceanic and Atmospheric Administration (NOAA) awarded Martin County, Florida more than \$4 million for an oyster reef habitat restoration project under the American Recovery and Reinvestment Act (ARRA). This project used more than 30 million pounds of cultch to construct approximately 25 acres of reef within the St. Lucie and Loxahatchee River estuaries providing social and economic benefit to the community, in addition to long-term ecological improvements. Construction used GPS positioning for barge supported placement of relict oyster shell and small limestone rock.

As one measure of the success of the restoration effort, several oyster biological parameters are being monitored at four restoration sites in the St. Lucie estuary and at one site in the Loxahatchee River. Those measures include: oyster distribution and abundance, reproductive development, juvenile recruitment, and prevalence and intensity of the oyster disease *Perkinsus marinus* (dermo). In November 2009, monitoring began at two completed restoration sites in the central portion of the St. Lucie estuary. As reef construction progressed, monitoring at two additional stations located in the north fork and lower body of the SLE began in February 2010. Finally, monitoring at the restoration site in the Loxahatchee River was initiated in August 2010. Live oyster densities at the central estuary restoration sites have increased substantially, reaching mean densities of greater than 400 m⁻² by October 2010. Mean oyster densities at the other two sites were near 100 m⁻² that same month. Despite the fact that reef construction had only been completed in August at the Loxahatchee site, there was approximately 14 juvenile oysters m⁻² present in October 2010. Additional monitoring efforts include passive acoustic monitoring, benthic trap sampling and sediment deposition tracking.

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Restoration of a Tidal Salt Marsh along the Raritan River Using Intensive Adaptive Management

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Restoration of a 30-acre tidal marsh along the highly urbanized Raritan River in Edison, New Jersey was undertaken to control monocultural stands of *Phragmites australis* that dominates tidal wetlands throughout the watershed. The restoration of a native salt marsh plant community was facilitated by an intensive 5-year adaptive management program that included annual fall herbicide application and an initial physical disturbance of standing dead growth (i.e., cutting and grinding). A diverse native salt marsh community characteristic of historical salt marsh communities within the Raritan River basin has been restored from the seed bank as well as natural seed dispersal. The restoration project has also increased habitat diversity and structure by increasing tidal exchange throughout the tidal marsh; facilitated by the development of new secondary channels as well as the adjustment of primary channels back to a more sloped, natural cross-sectional morphology. The results of this study are consistent with recently published studies which suggest that the dominance of *P. australis* is not indicative of a potentially diverse underlying native seed bank and that maintained control efforts can rapidly lead to a species-rich native plant community. While recognizing the importance of site elevations and tidal exchange on a potential restoration site, this approach represents a practical, cost-effective restoration strategy for *P. australis* dominated tidal marshes.

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Real Estate Acquisition: Post Hurricane Katrina

Willie Patterson

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Hurricane Katrina caused millions of dollars of damage to the gulf coast of Mississippi: flooding and destruction of homes. The Mobile District was tasked to build fifteen interim projects in Mississippi to solve some immediate concerns as a result of the storm. Most of the projects involved real estate acquisition. Some of the projects valuation determination yielded off-setting benefits as a result of the project features, thus no compensation was due landowners, while other projects required permanent acquisition and relocation. Some property values fair market value was less than the mortgage balance on the acquired property, creating challenges for the real estate team. This session will address the real estate challenge associated with acquisition of property after a natural disaster.

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Oyster Restoration in Maryland

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Hatchery-based oyster reef restoration has been ongoing in Maryland for just over 10 years. The primary goal has been to repopulate barren historic oyster bars with hatchery-produced juvenile oysters (spat) settled onto oyster shells. Hatchery produced oysters are necessary because the rates of natural recruitment in most Maryland waters have fallen to historic lows. Large-scale, long-term goals include augmenting the fishery, increasing natural recruitment and facilitating the development of disease resistance in the population. Short-term goals are to rebuild reef structure locally by planting oysters at high densities and protecting them from harvest either permanently in sanctuaries or temporarily in reserves that are harvested after several years. To date, the effort has been widespread, creating small plots (3 to 5 hectares) of restored reef on historic natural oyster bars throughout the upper region of the Maryland portion of Chesapeake Bay.

The restoration effort has been necessarily experimental to a great degree, testing restoration techniques and studying the ecological impacts of reef restoration. To date, monitoring and research has shown that the oysters can be long-lived; they create complex benthic habitat, host an abundant benthic community and process nutrients at remarkably high rates. In general, the ecoservices provided by these reefs is thought to be substantial but because they are small and widespread, these services may not be obvious or easily measured. Future efforts may be focused within a few tributaries to create larger scale reefs in smaller systems to allow more quantitative assessment of ecosystem changes catalyzed by oyster reef restoration.

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Geomorphic Response of the Souhegan River to the Removal of the Merrimack Village Dam

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The Souhegan River is a tributary of the Merrimack River that drains a 568 km² watershed in southern New Hampshire. The lowermost barrier on the Souhegan River was the ~4-m high Merrimack Village Dam (MVD, ~500 m upstream of the confluence with the Merrimack River), demolished and removed starting on August 6, 2008. The MVD was built in 1906 at a location where various dams have existed since the 18th century. Based on a pre-removal sediment-thickness survey, the MVD impounded at least 62,000 m³ of sediment, mostly sand. Analyses of topography, historical maps, and photographs suggest that approximately twice the area of the modern impoundment has been affected by over 200 years of damming at the site. We use monumented cross sections, longitudinal profiles, repeat photography, and sediment samples to document the response of the Souhegan River to the removal of the MVD. A base level drop of 3.9 m caused a two phased response. The initial phase was characterized by rapid incision and removal of the sand-sized sediment (796 m³/day), followed by channel widening. At base level, the rate of sediment removal slowed (24.2 m³/day) and the former impoundment segmented into a non-alluvial, bedrock and boulder controlled reach, and an alluvial sand and gravel reach with erosion and deposition modulated by vegetation on the channel banks. One year after the removal, the Souhegan River had excavated 40,300 m³ (65%) of sediment from the modern impoundment. Two years after the removal, two high-magnitude floods excavated another 10,600 m³ for a total of 50,900 m³ (82%) of sediment from the modern impoundment. Continued response will be substantially influenced by the establishment of bank vegetation within the former impoundment and the magnitude and frequency of high discharge events. We explore implications of our findings in this sand-filled impoundment for future dam removals.

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The Baltimore Watershed Agreement: Challenges and Successes of Collaborative County, City, and NGO Public Outreach and Awareness Efforts and Restoration Projects

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Public outreach and awareness is a key component of the Baltimore Watershed Agreement Action Plan (BWAAP). In addition to efforts by County and City governments, citizen-based watershed organizations and regional non-profit water quality and natural resource organizations play a major role in engaging and motivating citizens around these issues. The BWA commits the County and City to continue to work cooperatively with watershed associations on public outreach and awareness efforts to benefit water quality and protect the natural resources of the region.

The BWAAP commits the County, City, and NGOs to establish and conduct joint public awareness efforts. Baltimore County plans to mirror the existing City “Cleaner Greener Baltimore” campaign to encourage citizens to act responsibly about their trash disposal. While public outreach campaigns can be very expensive for individual organizations, this regional approach can reach a large audience more cost effectively.

Another BWAAP action is to expand collaborative outreach efforts through organizing roundtable discussions to engage organizations which may not be involved in watershed efforts. A collaborative outreach effort to the faith-based community led to a successful roundtable meeting in 2009. This effort engaged leaders from several denominations. It included discussion about on the ground activities at institutional sites as well as the land ethic responsibility of congregation members.

Faced with increasing responsibility for compliance with environmental regulatory programs, Baltimore County and Baltimore City recognize the value of NGO partnerships for BWAAP outreach and awareness efforts. NGOs are often better poised to engage and activate the community on water quality and watershed issues than government. The County, City, NGOs, and other stakeholders involved in the BWA all realize the importance and challenge of engaging citizens to accomplish watershed and water quality goals.

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Habitat Improvements to the Motor Island Shoreline in the Upper Niagara River, NY: A Collaborative Approach

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The New York Power Authority is responsible for the design and implementation of the Motor Island Habitat Improvement Project (HIP), located near Grand Island, NY in the Upper Niagara River, one of several ecological restoration projects that stemmed from a collaborative process related to the Federal Energy Regulatory Commission Relicensing of the Niagara Power Project. The Motor Island HIP involves improving shoreline habitat diversity and ecological function, while also preventing additional shoreline erosion at a 6-acre island managed by the State for wildlife conservation. Surveys of naturally-occurring reference wetlands were conducted to identify key design criteria, including water depths, a range of native vegetation types, species and their preferred elevations relative to water levels, substrate types, and degree of exposure to wind, waves, boat wakes, and ice. These design criteria, in addition to hydraulic and ice modeling, were used to develop a series of small shoreline-scallops, protected by low-elevation rock berms, that utilize bioengineering and native planting approaches to create a variety of interior habitat types ranging from riparian forest down through shallow emergent marsh and submerged aquatic vegetation zones. The project is being conducted through the guidance and direction of a collaborative, multi-stakeholder group that consists of representatives from Federal and State resource agencies, Indian Nations, non-governmental groups, and individuals. Through this process, the group revised the original design objectives, leading to a new design that offers improved ecological function of the proposed HIP, as well as additional stakeholder buy-in.

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Ecosystem Restoration with Gorilla Tactics: Restoration of Grand Lake St. Marys Ecosystem through Economic Development

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Grand Lake St. Marys is a 21 square mile lake supported by a 52 square mile watershed in north western Ohio and has been an influence on the local and regional economy within Auglaize and Mercer Counties, West Central Ohio since its creation. As the health of the lake and its native habitats has thrived, so has the economy. However, the health of the lake in recent years has felt the drastic cumulative effects of gradual land use changes, related to both growth and development surrounding the immediate lake area and the agricultural industry boom within the surrounding watershed.

These impacts have affected both recreational and economic activities throughout the lake communities. Although numerous plans to reduce the levels of pollution entering the lake have been developed over the years, the lake's water quality continues to suffer from nutrient inputs and other water quality degradation issues leading to dangerous levels of algae microcystin toxin. These threats endanger public health and welfare. Algae blooms were of such a magnitude and duration during the summer of 2010, that the Ohio Environmental Protection Agency was forced to close the lake to all recreational activity. Overall, the lake is on the verge of a functional breakdown and ecological collapse. Despite improved conservation practices over the years, the algal blooms are clear indicators of the ecosystems inability to process and utilize the excess and accumulated nutrients.

A Strategic Plan was formulated to provide a framework and timeline for restoration of the lake ecosystem utilizing various projects and economic management tools to implement solutions for current and future lake improvements and revitalization. The Strategic Plan was prefaced on the developing economic opportunities and activities that stem directly and/or indirectly from restoring degraded natural resources within Grand Lake St. Marys (GLSM). The creation of an economy derived from restoration of the lake within the GLSM watershed, will provide a new direction that is both environmentally sustainable and economically viable. Recognizing and correcting problems created by current and past activities and applying a new environmental and economic paradigm to the future offers a challenging, yet unique and exciting opportunity for the communities that have come to rely on the lake and watershed.

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Applying Adaptive Management to Improve Water-Quality Decision Making: Implications for Restoring the Nation's Largest Estuary-Chesapeake Bay

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The Chesapeake Bay and many estuaries in the Nation have been adversely affected by excessive inputs of nutrients resulting in low dissolved oxygen, loss of submerged aquatic vegetation, and toxic algal blooms. The Chesapeake Bay Program (CBP), a partnership between the Federal Government and the states within the Bay watershed, has attempted to restore water quality since the 1980s. The USEPA recently issued a Total Daily Maximum Load (TMDL) to apply a more regulatory approach to meet standards for dissolved oxygen and water clarity. The TMDL mandates that all practices designed to improve water-quality need to be in place by 2025 with 60 percent of the Bay meeting water-quality standards. The USGS, as part of the President's Executive Order for Chesapeake Bay, is working with CBP State and Federal agencies to employ an adaptive-management framework to help managers focus implementation, assess improvements, and adjust water-quality policies.

Results from watershed models are being used to help managers select the types and locations of practices and policies to improve water quality. The USEPA is using a deterministic watershed model to set the nutrient and sediment allocations for the TMDL. The USGS has complementary statistical models that provide refined spatial information on the sources and transport of nutrients and sediment. The results from the USGS models are being used by USDA to further focus Farm Bill funds to improve water quality in the Bay watershed and are being considered by the states in planning for the new phase of TMDL implementation.

A monitoring network is being used to assess changes in nutrient and sediment in the Bay watershed. There is a high degree of variability in nutrient and sediment loads throughout the watershed, mostly due to variations in streamflow. The USGS has improved techniques that remove the influence of streamflow and seasonal variability to assess anthropogenic changes in water quality. When these techniques are applied, a slow decline in the concentrations of nitrogen and phosphorous is evident from the late 1980s through 2009 at a majority of the sites in the watershed, with fewer sites also showing a decline in sediment.

Research on factors affecting nutrient loads is also used to help prioritize the locations of management actions and evaluate progress toward meeting the TMDL. One of the primary factors being examined is the influence of watershed characteristics on nutrient transport. In-stream loss reduces nutrient loads by up to 90 percent in some streams in the Chesapeake Bay watershed. This attenuation is an important factor when considering locations for management actions. Groundwater supplies a significant amount (about half) of water to streams in the watershed and is therefore an important pathway for nitrogen transported to Chesapeake Bay. The age of ground water in shallow aquifers in the Chesapeake Bay watershed ranges from modern (less than 1 year) to more than 50 years, with a median age of 10 years. The results are being used to consider the location of practices and understand the "lag time" between implementation of practices to reduce nutrients and the response in the Chesapeake Bay ecosystem.

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Designing Collaborative Approaches for Effective Adaptive Management

Jennifer Pratt Miles

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This presentation will outline steps for designing a collaborative process for stakeholder participation in an adaptive management program based on the Comprehensive Everglades Restoration Plan (CERP) Adaptive Management Integration Guide and drawing from the experience of adaptive management programs across North America such as the Las Cienegas National Conservation Area, Platte River Recovery Implementation Program, and Missouri River Recovery Program. Topics covered in this presentation will include: definitions of the terms “stakeholder” and “collaboration”, a range of activities that can be taken to engage stakeholders, and strategies for making decisions in the context of multiple, divergent objectives. This presentation will include examples of different models for collaborative governance and strengths and challenges associated with each.

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Using Landscape Connectivity Models to Inform Prioritization of Restoration Projects

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Regional restoration planning is emerging nationally as a means to promote better coordination among restoration practitioners, planners, and project decision-makers to ensure that the most meaningful ecological outcomes are realized. Even when a candidate restoration project meets established site-specific ecological, economic, regulatory, or aesthetic goals, it is important for the ecological value of a project to be considered in the context of the larger landscape. By planning habitat projects in view of the broader landscape and the species and communities which inhabit it, ecological value can be enhanced by ensuring the project site's connectivity with other neighboring habitat areas. Using frameworks from the fields of conservation biology and metapopulation theory, we show how landscape connectivity models can be used to guide the planning and prioritization of restoration projects. Use of such approaches early in the planning process can ensure that restoration projects simultaneously meet stakeholder expectations while maximizing ecological value at the landscape scale.

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Sustainable Dredged Material Management through Beneficial Use

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The U.S. Army Corps of Engineers has the responsibility to maintain navigation in more than 11,930 miles of waterways across the US. This task requires the dredging of more than 300 million cubic yards of sediment annually resulting in the need for methods to evaluate and determine environmentally and economically sound management alternatives. Management alternatives may include open-water, near shore or upland placement, each having opportunities to provide a beneficial outcome besides just maintaining navigation. Managing the disposal of dredged material in ways to benefit the coastal environment and keeping the sediment in the littoral system is encouraged under the Regional Sediment Management (RSM) policy. In the last three decades, aquatic placement of dredged material for any reason has become more restrictive under state authority, resulting in more dredged material being placed in confined disposal facilities (CDFs). Many CDFs are at or near capacity, requiring increased beneficial use of dredged material.

The beneficial use of dredged material is not a new concept. Engineer Manual (1110-2-5026) discusses numerous beneficial uses of dredged material in aquatic, wetland and upland habitats. Ten categories of beneficial uses are: 1) Habitat development (wetland, upland, island, aquatic including migratory and nesting use by waterbirds, shorebirds, and waterfowl), 2) Beach nourishment, 3) Aquaculture, 4) Parks and recreation, 5) Agriculture, forestry, and horticulture, 6) Strip mine reclamation and solid waste management, 7) Shoreline stabilization and erosion control, 8) Construction and industrial use (including port development, airports, urban, and residential), 9) Material transfer (fill, dikes, levees, parking lots, roads), and 10) Multiple purpose. Beneficial uses of dredged material have been classified into three broad categories: engineered uses, agricultural and product uses and environmental enhancements.

Environmental enhancements offer the best use for large volumes of material during the dredging process and have greater support in terms of cost sharing. This presentation will provide examples of habitat enhancements in both aquatic and upland environments, describe the evaluation process to determine suitability and discuss challenges and opportunities in implementing beneficial use projects using dredged material.

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The Application of Reference Condition and Concepts to Assessing Restoration Benefits

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The overarching goal of the U.S. Army Corps of Engineers' (USACE) ecosystem restoration mission is to restore structure, function, and dynamic processes to degraded aquatic ecosystems. Reference concepts can play several roles in achieving this goal; they serve as a "target condition" for restoration designs, they provide controls for monitoring programs, and they have the potential to provide a framework for quantifying project and programmatic benefits. This presentation focuses on the application of reference concepts to assessing environmental benefits. A general framework is proposed, and the application of the concepts to ecosystem restoration projects and programs described. The use of a reference-based framework provides correspondence within and across ecosystem types, streamlining benefits assessments for projects while also facilitating programmatic trade-offs and roll-ups. Requirements for implementation include the identification of appropriate ecosystem attributes and metrics, development of an assessment protocol and the establishment of an appropriate suite of references. These considerations are discussed and weighed against alternative approaches for benefits assessment.

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Development and Application of a Piedmont Stream Conceptual Model

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As a result of agricultural development, urbanization, and countless other historical and modern threats, stream systems throughout the Appalachian Piedmont have undergone significant changes to their geomorphic condition, flow regime, water chemistry, and connectivity. In recent years, the public has displayed a growing appreciation for value of functioning stream ecosystems, and the Piedmont has developed a multi-million dollar stream restoration and mitigation industry. A comprehensive understanding of stream structure, function, and process is necessary to effectively plan, design, monitor, and adaptively manage these projects. Furthermore, funding agencies must justify their restoration investments in terms of environmental benefits and ecosystem services provided by a single project as well as a suite of projects. To this end, a conceptual model of Piedmont streams was developed to link regional drivers and stressors to their effects on freshwater ecosystem services. This presentation will: (1) review legacy and contemporary human impacts to Piedmont streams, (2) present a conceptual model of stream function and process applicable throughout the Piedmont, and (3) demonstrate the simplification and application of this conceptual model to a small-scale stream restoration project on Allatoona Creek, Georgia. The regional conceptual model presented herein not only provides a tool for informing stream restoration science, but also can help communicate restoration actions and results among diverse project teams, funding agencies, and the public at large.

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Everglades Restoration Transition Plan: A Multi-Species Approach to Water Management within South Florida

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Water management within the greater Everglades system is a complex balancing process involving consideration of the varied and often competing needs of endangered species, water quality, water supply, flood control and cultural resources. Water Conservation Area 3A (WCA-3A) is located on the northern boundary of Everglades National Park (ENP) and is regulated to provide flood control; water supply; regional groundwater control and prevention of saltwater intrusion; enhancement of fish and wildlife; and recreation. WCA-3A also provides habitat for endangered species such as Everglade snail kite and wood stork, while the endangered Cape Sable seaside sparrow resides downstream of WCA-3A within ENP.

Water management within WCA-3A is currently governed by the Interim Operational Plan (IOP) which was formulated in response to a 1999 U.S. Fish and Wildlife Service (FWS) jeopardy opinion on the Cape Sable seaside sparrow and includes restrictions on WCA-3A water releases in order to maintain appropriate nesting conditions within sparrow habitat in ENP. WCA-3A historically has been an important snail kite nesting area, fledging a large proportion of young in the region. However, there were no young fledged from WCA-3A in 2001, 2005, 2007, 2008, or 2010 and only 2 young fledged from WCA-3A in 2009. Recent research has identified three potential adverse effects on the snail kite associated with hydrological conditions within WCA-3A under IOP: prolonged high water levels, prolonged low water levels and rapid recession rates. In order to address these effects, FWS developed a Multi-Species Transition Strategy (MSTS) for WCA-3A that specifies seasonal depth targets for the protection of multiple species.

To better manage for multiple species, the Corps, FWS and other agencies conducted an extensive review of meteorological, hydrological and species data, along with previous water management decisions to identify a suite of operational flexibilities within the current system constraints to better manage for multiple species needs, culminating in the development of the Everglades Restoration Transition Plan. This plan represents a paradigm shift from the singlespecies management approach embodied by IOP to a management strategy that includes consideration of current hydro-meteorological conditions, project specific performance measures based upon the FWS MSTS, observed species data, and Periodic Scientists Calls. The National Academy of Sciences has commended this multi-agency approach to improve water management and ecological conditions within WCA-3A during the transition to Everglades' restoration (Committee on Independent Scientific Review of Everglades Restoration, 2010).

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Leadership Challenges and Opportunities for Maximizing the Learning and Successes of Fast-Paced Large-Scale Projects While Adapting Bureaucratic Processes and Practices to Secure Great Successes

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The intent of bureaucratic processes in public-service organizations is to ensure consistent and quality products. These processes, however, can be time consuming. The need to adapt bureaucratic processes and practices to maximize the positive and quality outcomes of fast-paced large-scale project successes has been evident in the implementation of the Indian River Lagoon South (IRLS) project. This \$2.1B project has been in public demand for implementation for the past few years and presents leadership challenges and opportunities at all levels of the organization.

The project comprises the restoration of natural areas and construction of several large reservoirs and storm-water treatment areas to restore the Saint Lucie Estuary and southern portion of the Indian River Lagoon. This highly valued system is considered one of the country's most productive and most threatened natural systems, and it is often described as Florida's Space and Treasure Coast. The system is home to more than 4,300 species of plants and animals and supports an annual economic contribution of more than \$730 million. Communities, natural resources, and the local economy will benefit greatly from the successful restoration of these water resources.

It is essential for organizations to assign successful leaders and to keep a close oversight and support regarding large-scale project executions. Fiscal year 2010 was a highly intense, focused, challenging, complex, and highly effective year for proven leadership and management not only for the IRLS project, but also for the Comprehensive Everglades Restoration Program. Effective execution of the IRLS project helped keep a healthy ecosystem program for many years and helped secure the obligation of millions of dollar in stimulus funds. The uncommon project needs and characteristics demanded transformational leadership skills and great partnership visions at all levels of the partner agencies, the U.S. Army Corps of Engineers and South Florida Water Management District.

The major challenges faced and key lessons learned will be discussed.

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Where Should We Act and at What Scale? Defining the Meaning of Restoration from an Ecological Perspective

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As restoration practitioners collectively imagine a national network of regional scale restoration programs, it will become increasingly important for decision makers to define priorities for where and at what scale restoration actions should be taken. Understanding of the relative value of restoring any single location requires us to consider the proposed restoration action among a hierarchy of perspectives. The importance of the regional ecosystem to global evolutionary process (the presence of rare/threatened species, and the contribution that the region makes to global diversity of any class of organisms) is integral to deciding where to focus support among regional scale ecosystem restoration programs. The existing trend of change within the region is critical for determining where to act first, and at what scale to invest in action. And finally, the direct effects of the project on the site where it is constructed and the immediately surrounding areas must be carefully considered in order to optimize project design and to maximize restoration effect. The current status of restoration planning is focused on local project effects mainly, and a few regions are developing characterizations of regional trends. It has been my experience that the global perspective is almost never discussed. Luckily, ecologists have been developing inventories of natural systems for much of the last century and many of these information syntheses are ready to be inserted in the thread of an increasingly nationalized strategy for ecological restoration and inform what it means to make wise use of ecological resources.

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How Much Flow is Enough? Contrasting the Role of Riverine Inputs in Estuarine Ecosystem Restoration in California Bay-Delta and the Mississippi Delta

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Riverine inputs to estuaries are unpredictable due to natural variability at seasonal and inter-annual time scales and the role of river management. In addition, the specifics of estuarine ecosystem needs vary from system to system even to the point that terminology requires redefinition. For example, 'diversions' on the Sacramento River generally remove water which would otherwise be beneficial to the ecosystem, while on the lower Mississippi 'diversions' are a restoration tool used to reintroduce flows into wetlands which have been isolated from riverine flows. This presentation will contrast the way in which riverine inflows are being considered in restoration planning in the California Bay-Delta (CBD) and in the Mississippi Delta (MD) in coastal Louisiana.

In the CBD alteration of the natural hydrograph by dams and upstream diversion of flows has been dramatic, especially on the San Joaquin. In addition, water management to support exports and massive drainage of tidal wetlands have changed an area once influenced in turn by floods and tides into a system of rock-bounded channels that are little more than conveyance channels for flood and ebb tides. The Mississippi River in coastal Louisiana is similarly constrained by flood control levees and efficiently conveys water to the Gulf of Mexico with minimal interaction with the surrounding deltaic plain. In contrast to the CBD, the landscape of coastal Louisiana is still largely dominated by wetlands but freshwater estuarine gradients are maintained by precipitation and storm water rather than riverine inflows.

The key to wetland restoration in both of these systems is sediment. In both the Sacramento and the Mississippi the pattern of sediment delivery has changed greatly in the 20th century, as dams for water supply and flood control were placed on headwaters, and river channels were armored and, in the CBD, as a slug of hydraulic mining debris from the late 19th century moved through the system. For the 21st century in both systems riverine inputs of sediments represent a renewable resource which must be captured to rebuild and sustain wetland habitats. And floods, the very threat to economy and society which much of the river management was designed to eliminate, are the greatest sediment source. Estuarine wetlands develop based on the dynamic balance of flows between the river and tide, between floods and coastal storms. For estuaries the 'systems' approach is more than just a bigger view, it's an essential view.

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Using Science to Inform Decision Making in the Face of Uncertainty: A Tool for Prioritizing Coastal Restoration and Protection Projects in Louisiana

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Louisiana's 2007 Comprehensive Master Plan for a Sustainable Coast (Master Plan), lays out a broad direction for restoration and protection in coastal Louisiana by identifying four coastwide planning objectives. The 2012 legislatively mandated update of the Master Plan will be an implementable plan that identified specific projects and outcomes. This requires the selection and implementation of ecosystem restoration and hurricane protection projects in support of the 2007 objectives from the wide array of ideas and concepts that have been proposed for the coast over recent years. To support the development of the 2012 plan a planning tool has been developed that supports the prioritization and grouping of individual projects based upon their projected progress towards the objectives along with other decision criteria and planning constraints, such as funding availability. This selection process includes three main components: defining desired outcomes, estimating project effects, and prioritizing projects/assembling portfolios.

The lack of clearly articulated desirable outcomes in previous coast-wide planning processes in coastal Louisiana has meant that discussion of important trade-offs among coastal uses has only been confronted late in the planning process. This process begins with the definition of a vision for the future coast based on spatially varying levels of ecosystem service provision and risk reduction from storm surge damages.

The vision for the coast must be technically achievable and is translated into a series of specific targets. How various projects reach those targets is tested using a set of predictive models. These are embedded in a number of linked modules that predict change in the nature of the Louisiana coastal system under both future conditions without restoration projects and as a result of project implementation. Each module also considers important but uncertain factors which drive the dynamics of that aspect of the system. These uncertainties are used to develop scenarios reflecting the potential range of these external factors. Thus, for each aspect of vision, multiple values reflecting the scenarios, are generated for each project evaluated.

The outputs from these models are used to identify progress towards the targets and how projects reflect a set of decision criteria, or preferences. Projects are then prioritized using a multi-criteria approach and assembled into portfolios based on constraints such as available funding levels, river flows, etc. Portfolios are then re-tested using the project effects models to ensure that synergies and/or conflicts among projects are considered in determining which groups of projects best achieve the future vision of the coast.

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Gulf Coast Restoration Mississippi Style – Achieving the Philosophy of the Gulf of Mexico Alliance through the Mississippi Coastal Improvement Program

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The Gulf of Mexico Alliance (GOMA), initiated in 2004, is a partnership of the states of Alabama, Florida, Louisiana, Mississippi, and Texas, with the goal of significantly increasing regional collaboration to enhance the ecological and economic health of the Gulf of Mexico. The five U.S. Gulf States identified six priority issues that are regionally significant and can be effectively addressed through increased collaboration at local, state, and federal levels: Water Quality; Habitat Conservation and Restoration; Ecosystem Integration and Assessment; Nutrients & Nutrient Impacts; Coastal Community Resilience; and Environmental Education.

The Mississippi Coastal Improvements Program authorized by Congress in 2005 as a result of the devastation caused by Hurricane Katrina in coastal Mississippi is a multi-faceted, systemwide, integrated, phased program addressing hurricane and storm damage risk reduction, salt water intrusion, shoreline erosion, fish and wildlife preservation, and other water resource related issues. This program was developed in full coordination with the GOMA effort and is making significant contribution to addressing the six priority areas as relates to the Mississippi coast.

- Water Quality for Healthy Beaches and Seafood: Restoration of barrier and near-shore islands, coastal marshes and wetlands, and diversion of freshwater water will lead to improved water quality.
- Reduced Nutrient Impacts to Coastal Ecosystems: Restoration of coastal marshes and wetlands and conversion of developed areas into marshes, wetlands, and green spaces will reduce the input of nutrients into coastal ecosystems.
- Habitat Conservation and Restoration: Restoration of barrier and near-shore island habitats and moving private lands into the public sector will provide for habitat conservation and restoration.
- Increased Coastal Community Resiliency: Restoration of barrier and near-shore islands enhances protection of mainland areas. Acquisition of private lands into the public sector and relocations outside the floodplain reduces impacts of future storms and hurricanes and increases resiliency and sustainability.
- Education: Inclusion of evacuation planning, floodplain management and other issues under the purview of local and state entities increases community resiliency and supports the other GOMA issues.

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Mapping Submersed Aquatic Vegetation Species Using an Airborne Hyperspectral/Lidar System

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Submersed Aquatic Vegetation (SAV) is an important indicator of environmental quality and provides a variety of ecological benefits, including the prevention of coastal erosion and the provision of fisheries habitat. However, populations of SAV are declining globally, primarily as a result of reduced water clarity in part due to the potentially adverse impacts of dredging and sand mining. Since impacts can vary among species due to their variable tolerance levels to environmental conditions, it is important to understand species distributions. In addition, understanding the species composition and spatial distribution of SAV is critical for planning dredging operations, mitigating ecological damage, monitoring SAV, and restoration planning. Most SAV mapping studies have utilized aerial photography and multispectral imagery to identify the areal coverage and density of seagrass beds. In addition, videographic systems have also provided good spatial resolution for the detection of SAV presence. More recently, hyperspectral imagers are used to map specific characteristics of SAVs because they provide the advantage of detailed spectral information at very high spatial resolutions. Hyperspectral imagery is proving useful for SAV species discrimination through research in recent laboratory experiments, field tests, and application studies. This is due to an increased understanding in the detection of subtle spectral characteristics of different bottom types, as well as the separation between plant signals and water column interference. Even more recent is the use of bathymetric light detection and ranging (lidar) to identify bottom types through examination of water column attenuation and bottom reflectivity as it varies with water clarity. Ultimately, these new findings have prompted many scientists to believe that coupling hyperspectral imagery with bathymetric lidar could lead to improved SAV classifications and promising advances in aquatic vegetation studies.

This study will test the use of fused hyperspectral and lidar data to detect and discriminate species of macroalgae and SAV in two, small-craft dredged harbors, Plymouth Harbor and Buzzards Bay, MA. It utilizes imagery and data collected in September, 2010 by the U.S. Army Corps of Engineers (USACE) Joint Airborne Lidar Bathymetry Technical Center of eXpertise (JALBTCX). The airborne sensor suite, Compact Hydrographic Rapid Total Survey (CHARTS) system, features an Optech SHOALS-3000T20, with a 3-kHz bathymetric lidar and a 20-kHz topographic lidar, an Itres Compact Airborne Spectrographic Imager (CASI)-1500 for hyperspectral imaging, and a Duncan Tech-4000 RGB digital camera. Methods for characterizing the seafloor and water column using an image fusion strategy will be employed to ultimately identify and classify the different species of macroalgae and SAV present in the study areas. Ground truth data collected during the survey will be used to train and classify the species, as well as validate the accuracy of the results.

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The USDA Conservation Effects Assessment Project (CEAP) Wildlife Component

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Conservation programs funded through federal farm legislation have produced substantial fish and wildlife benefits in the United States in recent decades. Conservation practices are applied through these programs by farmers and ranchers with the assistance of Natural Resources Conservation Service (NRCS) planners and technicians. The USDA Conservation Effects Assessment Project (CEAP) is a multi-agency effort examining the environmental benefits of these conservation practices and programs. The effort is a response to the need to account for environmental benefits achieved through public conservation investments. The CEAP Wildlife Component is documenting fish and wildlife-related ecosystem services provided by USDA conservation actions. The effort involves a variety of assessment projects, most of which are applied at regional landscape scales through partnerships between the NRCS and elements of the fish and wildlife science and management communities. To the extent possible, effects measures are linked to established and evolving biological planning tools and products. For example, members of the bird conservation community have developed geospatial habitat and population objectives for many avian species and groups; CEAP Wildlife Component projects have assessed the contribution of USDA program enrollments toward meeting established bird conservation objectives. Specific projects to quantify benefits, from assessing improvements in habitat value, to documenting increases in habitat use by target species or groups, to estimating population responses, are summarized. Highlights of findings generated to date, prospects for future assessment efforts, and the reliance on sound partnerships among state and federal agencies, non-governmental conservation organizations and academia focused on effective evaluation that supports adaptive program delivery are presented.

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Benefit Transfer and Visitor Use Estimating Models of Wildlife Recreation, Species and Habitats

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Agencies often need information on economic values to defend the protection of wildlife habitat and for restoration project and budget justification. However, there is often insufficient time, money and expertise to conduct an original valuation study. Conducting a meta-analysis of available valuation studies, we provide benefit transfer values and functions to estimate the total economic value of habitats, including wetlands, aquatic resources and terrestrial, as well as species, including salmon and threatened and endangered species. These pre-programmed easy to use value tables and meta-analysis based valuation models allow non-economists to value habitats and species. The associated user manual provides guidance on selecting the appropriate model to estimate recreation use and existence values.

In addition, we have also estimated wildlife recreation use models for National Wildlife Refuges that are applicable to state Wildlife Management Areas. Finally we have estimated state level wildlife recreation use models for the lower 48 states that can be applied to privately owned and public lands that are potential habitat for game and non-game species. These estimates provide decision-makers with the appropriate information needed to estimate activity visits due to existing or proposed protection of lands and habitats, or the reduction in visits from habitat loss. Combining the benefit transfer valuation models (values per hunter, angler or viewer day) with the change in visitor days associated with the proposed protection allows calculation of annual values and present values of protecting wildlife habitat or avoiding losses.

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Marion Mill Pond Dam Removal and Stream Restoration for Great Lakes Fisheries Restoration

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The Marion Mill Pond dam was constructed on the Middle Branch River in 1878 to drive saw mills for Michigan's timber industry. Originally, this river supported a diverse trout population and upstream of the mill pond, a thriving Brook Trout population still exists. A tributary to the Muskegon River, the Middle Branch River also provided spawning habitat for potamodromous fishes in Lake Michigan. However, thermal and hydraulic impacts from the mill pond and dam have isolated fish populations in the upper section of the river and resulted in the near elimination of downstream cold-water trout habitat. Removal of the dam and draining of Marion Mill Pond would eliminate this barrier to fish passage and allow for reconnection and restoration of the fisheries ecosystem along this 33 mile river. We are conducting conceptual and feasibility analyses and design to develop dam removal and river restoration alternatives. Objectives of these designs will rely on a reference reach approach and allow the river, to the extent practical, to reestablish itself in its original channel, provide for natural flow and flood conveyance, return to natural thermal regime, and restore fish passage through this section of river, ultimately allowing unencumbered fish passage all the way to Lake Michigan. The design alternatives will be evaluated by comparing their environmental benefits and cost of dam removal with the continuing maintenance costs of the existing structure.

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A Gateway to Building a Strong Community of Practice for Ecosystem Restoration

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Ecosystem Restoration is one of the primary missions of the Civil Works program within the Corps of Engineers. The purpose of Civil Works ecosystem restoration activities is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. Ecosystem restoration efforts involve a comprehensive examination of the problems contributing to the system degradation, and the development of alternative means for their solution. The intent of restoration is to partially or fully reestablish the attributes of a naturalistic, functioning, and self-regulating system.

The Ecosystem Restoration Gateway concept was introduced at the Corps of Engineers National Planning Community of Practice Conference in 2008. The aim of the Ecosystem Restoration Gateway is to develop a body of information and knowledge that will create several sub-Communities of Practice (sub-CoP) which will then support practitioners in planning, designing, constructing and operating ecosystem restoration projects. The goal of the “sub-CoPs” is to allow individuals working on similar types of ecosystem restoration projects to network with each other and share information. The Gateway utilizes subject matter experts (SMEs) from across the country to help identify and organize the types of information and content that is useful to their sub-CoP. Since early 2009 five workshops have been held to begin building the Gateway content related to estuaries, fish passage, and river restoration. In addition a library has been organized on habitat models. Several additional restoration topics will be addressed in the future to include, wetlands, arid region restoration, lakes/ponds/reservoir restoration, environmental dredging and beneficial use of dredge material, floodplain restoration, and invasive species issues in restoration, among others.

This presentation will demonstrate the content and features of the Ecosystem Restoration Gateway. We will also be looking for interest from conference participants in sharing their information related to ecosystem restoration work that will continue to help us build this very powerful tool.

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Stormwater Outfall and BMP Assessment

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Under the Planning Assistance to States (PAS), the U.S. Army Corps of Engineers is authorized to provide water resources technical assistance to states on flooding, stormwater management, water supply and other water related issues. The PAS authority is designed to allow the Corps to quickly provide water resources technical expertise to states and local communities on issues of varying magnitude. Understandably, the services provided by the Corps under this program are highly valued and sought after, especially in light of the recent Presidential Chesapeake Bay Executive Order 13508.

Under the PAS authority, the Baltimore District has partnered with the Virginia Department of Transportation (VDOT), Stafford County, VA to conduct stormwater infrastructure and BMP assessments to address water quality issues. The purpose of the studies is to assist in compiling data and conducting a visual assessment on the existing stormwater infrastructure and BMPs within selected watersheds. The data collected and the methodology used to organize the data were designed to meet National Pollutant Discharge Elimination System (NPDES) "Municipal Separate Stormwater System (MS4)" permit for Total Daily Maximum Load requirements and the Chesapeake Bay Executive Order 13508, but also provide a foundation for operation, maintenance, and management decisions that our sponsors can use for planning purposes and future designs. Baltimore District has conducted a similar study for the U.S. Naval Academy as part of our planning support to DoD customers.

In conducting this work, the Corps produced an inventory and inspection of all stormwater infrastructure, BMP locations and conditions in a Geographic Information System (GIS) format and access database, which will aid the sponsors in meeting NPDES permit and Chesapeake Bay Executive Order water quality requirements. The overall work involved the use of the latest GPS and GIS technology and development of an advanced multi-use access database to make data collection and inventory more streamlined and efficient. To date, the Corps has surveyed and assessed over 7,000 outfalls and 1,500 BMPs across Northern Virginia. The field collection techniques and overall procedures created by the Baltimore District are now being used by other Corps districts, State agencies and private contractors to complete BMP and Outfall inventory and inspections throughout other parts of Virginia.

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Modeling Project Alternatives for the Anacostia Restoration Plan

Andrew A. Roach, *Angela Sowers, Dave Robbins and Mary Dan*

U.S. Army Corps of Engineers, Baltimore District, Baltimore, MD, USA

The Anacostia Restoration Plan (ARP) is the product of a 2-year planning effort to produce a systematic 10-year plan for environmental and ecological restoration across the entire Anacostia River Watershed. This urban watershed flows through Montgomery and Prince George's Counties in Maryland and through parts of Washington, D.C. The Anacostia is a tributary to the Potomac River, with more than 860,000 people living in the 176-square-mile watershed. Urbanization of the watershed has caused increased runoff volume and velocity, reduced groundwater recharge, diminished water quality, and degraded riparian areas and aquatic habitat. The ARP was developed as a holistic plan that addresses the watershed's problems comprehensively – bringing many independent restoration actions into one cohesive plan of action, enhancing communication and collaboration among all stakeholders.

The ARP identifies more than 3,000 restoration opportunities across the 14 primary subwatersheds and the tidal river reach. Candidate projects target eight action-oriented restoration strategies: (1) stormwater retrofits, (2) stream restoration, (3) wetland creation/restoration, (4) fish blockage removal, (5) riparian reforestation, (6) trash reduction, (7) toxic remediation, and (8) parkland acquisition. Potential restoration opportunities were first identified via a desk-top GIS exercise. Nearly all potential project sites were visited and assessed in the field, with many potential projects rejected because of site-specific constraints. After a final list of all restoration opportunities was developed, each opportunity was evaluated independently, resulting in a ranking of candidate restoration projects within each primary subwatershed.

A modified version of the Watershed Treatment Model (WTM), developed by the Center for Watershed Protection, was used to estimate pollutant reduction for stormwater retrofit and street-sweeping (trash reduction) projects. In addition to pollutant reduction, about 20 other variables were used to score and rank each project. Variables included a range of factors such as environmental benefits, impacts, feasibility, estimated cost, outreach and community connection, and permitting. Based on the combined analysis of these various factors, projects were prioritized across the entire basin so that, following the publication of the ARP, restoration efforts could focus on discrete actions in specific areas. In addition, to improve synergies among projects and to focus restoration efforts, clusters of high scoring stormwater retrofit projects were identified, and all projects within a specified distance around the projects were included as a priority cluster. This innovative approach to watershed planning has resulted in a restoration plan endorsed by local watershed groups as well as state, local, and federal governments and resource agencies.

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A Systems Framework for the Bay-Delta: A Regional Perspective

Paul Robershotte, Stu Townsley and Cindy Tejada

U.S. Army Corps of Engineers, San Francisco, CA, USA

Panel Overview:

The Bay-Delta is California's hydraulic heart with very valuable, but fragile ecosystem, conveyance, and flood systems. Despite significant Federal spending and a comparable State share over the past 15 years, the ecosystem has continued to deteriorate. Continuation along the same path is not a viable option. The risks remain real – imperiled water supply for 25 million residents, scant irrigation water for 9 million acres of the nation's most productive farmland, and threatened critical energy and transportation infrastructure that supports the 8th largest economy in the world. In addition, there are fifty-five (55) ESA-listed species in the Delta. These risks transcend the California legal Delta boundaries, and they need to be considered as part of an overall system that encompasses natural and engineered waterways, regional environmental health, public safety, and national, regional and local economic livelihood. One must also consider the political context created as a result of Federal, State and local government responsibilities and the myriad of interested stakeholders.

Presentation Summary:

Mr. Paul Robershotte, Special Advisor for Integrated Water Resources at the US Army Corps of Engineers South Pacific Division, will be the second speaker in a moderated panel discussion entitled "A Systems Perspective on Addressing Water Resources Challenges in the Sacramento – San Joaquin Bay Delta," providing the regional perspective.

As the decline of the Bay-Delta ecosystem has accelerated in the last decade, awareness of this crisis has heightened, new alliances have formed and thinking has evolved about how to best solve Bay-Delta challenges. Agencies at all levels with responsibilities for water supply, flood risk management and ecosystem restoration now recognize the need for leveraging resources, combining projects and programs and working on a system wide basis. The Administration recognizes the urgency for action, as evidenced in its ongoing effort to address California's water issues in an aggressive and coordinated fashion. The Administration is giving priority attention to these issues because the Bay-Delta is among the most important estuary ecosystems in the nation. In addition, there is a larger global picture outside of USACE to move Government into an interagency problem solving and budgeting approach. It is critical USACE (and others) abandon the individual agency, project-by-project narrow focus and push toward true collaborative solutions. We are at a unique and critical juncture: the current climate is conducive to effecting change and USACE can contribute significantly. This is not "business as usual."

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Maximizing Wiregrass (*Aristida Stricta*) Reproduction for Restoration Purposes: Effect of Growing Season Month of Burn on Seed Production

Emily Rodriguez¹, Kimberly Bohn², Cheryl Mackowiak³ and Bill Cleckley⁴

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After a century of fire suppression, land conversion, and environmental degradation, many efforts are underway to restore wiregrass (*Aristida stricta*) to the groundcover as part of large-scale restoration efforts in longleaf pine (*Pinus palustris*) ecosystems. Throughout its geographic range, wiregrass was a dominant groundcover species and functioned as fine fuel for the spread of low intensity fires (Clewell 1989). Under natural conditions with frequent fire, wiregrass is vigorous and long-lived, but viable seed production and seedling recruitment are low. Yet, maximizing viable seed yields is now an important goal of land managers attempting to restore wiregrass populations across large landscapes as quickly as possible. Seed for restoration plantings is primarily harvested from relatively pristine donor sites, managed with growing season burns (Trusty and Ober 2009). It has been known for decades that wiregrass flowers more abundantly after growing season fires (Clewell, 1989); but the effect of timing of burn within the growing season on seed production has not been examined thoroughly, particularly across different climactic zones. Furthermore, there is some speculation that low viability of collected seed may be a function of the time of collection, which has typically been carried out from mid-November to mid-December.

Two study sites were located in xeric sandhill longleaf pine forests; one in the north Florida panhandle (Econfina Creek Water Management Area) and one in central Florida (Annutteliga Hammock). At each site, five by five meter plots were burned during each different month of the growing season (May, June, July, and August) with six replications and six plots were left unburned as a control. A split plot design was utilized with the whole plot reflecting month of burn and the split plots reflecting time of seed collection. Every two weeks, from mid-September through December, seed stalks were destructively harvested from a single wiregrass plant in the 30 plots at each site. Seed traps were placed in the center of each burn plot beginning in September and seeds found in these were counted every two weeks. Stalks were placed in paper bags and taken to the laboratory where their seeds were manually stripped and counted. These seeds were sent out for x-ray testing to determine their stage of development. If there were more than 10% filled seeds, this test was followed by tetrazolium viability and germination testing.

Preliminary data show that burning wiregrass during the months of May and June resulted in the greatest amount of seed produced (average number of seed stalks per plant: May=24, June=17, July=12, August=4). Seed trap counts show that peak seed rain occurred during the first two weeks in November. These results suggest that land managers attempting to maximize wiregrass seed production should burn during May or June and harvest the seed by early November.

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Adaptive Design of a Salt Marsh during Construction in a highly Urbanized Environment of New York City: The Alley Park Restoration Project

John Roebig¹, John McLaughlin² and Michael Feller³

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In urban estuaries in the northeastern U.S., many salt marsh restoration projects take place on severely degraded sites with little remaining characteristics of the original ecosystem and within watersheds that have been completely urbanized. Techniques for restoring and monitoring salt marshes in highly degraded sites are very site specific. Common design techniques such as bio-benchmarking, geomorphologic assessments, hydrological budgets and the use of reference vegetation communities are important in understanding the local a biological and physical restoration blueprint. While these techniques will increase the likelihood for a successful and self-sustaining restoration project, a dynamic and adaptive approach is required to accommodate unexpected site conditions identified during construction.

The Alley Park Restoration Project in New York City explored alternative ways to meet design objectives when challenges were encountered that required design changes during the construction phase to maintain the ecological objectives of the restoration. During construction of the Alley Creek salt marsh, construction crews encountered very deep unstable unconsolidated sediments that resembled "quicksand" like material. Extremely fine grained (clay, silt and fine sand) tidal marsh deposits that made grading impossible for even low pressure equipment. This resulted in the need to reconfigure the design, modify the planting scheme and guarantee requirements and reluctantly increase the mudflat community over the fine-grained material instead of the low marsh community originally planned for that location. Construction crews also encountered significant fresh-water seeps during the construction phase that led to a more ecologically diverse habitat over the previously solely salt marsh design. The lower salinity concentrations would have left the salt marsh more vulnerable to invasion by the common reed *Phragmites australis*. By quickly reacting to this information we were able update design drawings and modify construction activities to accommodate the establishment of a freshwater fen community adjacent to the Alley Creek salt marsh. In the end the ecosystem is more diverse than originally planned, and perhaps more representative of historic conditions. This paper discusses techniques used to design a sustainable urban ecosystem and lessons learned during the construction of this project.

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An Overview of the Collaborative Forest Landscape Restoration Program

Megan Roessing

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The Collaborative Forest Landscape Restoration Program (CFLRP) is an innovative new approach to restoration at the landscape-scale. The purpose of the CFLR Program is to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes. In 2010, ten CLFRP projects were selected. These projects span the country and each project includes partnership efforts on forest restoration treatments that reduce wildfire risk, enhance fish and wildlife habitats, and maintain and improve water quality. This presentation will provide an overview of the CFLRP program and examples of the restoration work planned and accomplished by the current projects.

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Ecological Models and Tools for Greater Everglades Restoration

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The Greater Everglades modeling community has made significant advancements in development of ecological models for evaluation and assessment of alternative restoration approaches. Joint Ecosystem Modeling (JEM) was established with the goal of getting ecological models into the hands of users, and collaboration has provided a mechanism to meet this goal. JEM is a partnership among Department of Interior agencies (USGS, USFWS, NPS), universities, and other organizations. JEM collaborators have made substantial progress in linking ecological and hydrologic models over the last several years, as well as developing user-friendly modeling and data tools requested by the user community, and standardizing model development and documentation processes. A model viewing and data manipulation framework, EverVIEW, provides a three-dimensional global view of the Earth's surface and serves as a common platform for models supporting Everglades restoration. Models deployable in the EverVIEW framework allow exploration population dynamics of indicator species across alternative restoration scenarios, and prediction shifts in the distribution of endangered species in response to climate change. We will present examples of models being used in the restoration planning process.

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Conceptual Ecological Model Updates for the Everglades: Climate Change Considerations

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The use of conceptual ecological models (CEMs) has been an effective tool for systematically organizing and prioritizing complex Everglades issues and a suite of these models was published in the journal *Wetlands* in 2005. In these non-quantitative models, anthropogenic drivers and stressors, as well as ecological effects and measurable attributes were described for most of the south Florida ecosystem being restored under the Comprehensive Everglades Restoration Plan (CERP). In the models that covered coastal geographic regions, such as Florida Bay and Indian River Lagoon, sea-level rise was briefly addressed as a driver. The CEMs for other geographic regions, such as Big Cypress, Everglades ridge and slough and the southern marl prairies did not consider sea-level rise or climate change as a driver on that portion of the system.

New information on climate change and associated sea-level rise has sparked a renewed effort to update the existing Everglades CEMs to help guide new hypotheses on potential impacts of climate change on restoration efforts. For the CEMs, this effort has started providing a detailed framework for scientists to articulate anticipated ecological change to resource managers. Sea-level rise is of particular concern because of the low elevation of much of the Southern Everglades.

Restoration of historic freshwater flows to the Everglades is considered the dominant factor in restoring ecosystem health and reliance required to maximize natural climate change adaptation capabilities. Understanding the interplay between fresh and saltwater is fundamental to effective resource stewardship of many species as well as for human water supply. The CEMs will allow resource managers to compare scenarios and monitor changes that would result from sea-level rise, restored freshwater flow or changes in ground water-withdrawals. Applying this understanding across the ecosystem has broad implications for resource managers. CERP projects are designed to restore and sustain the most critical functions in this ecosystem and these are crucial for managing the Nation's lands and sustaining the Nation's fish and wildlife species. CERP will benefit management of federally protected species such as the Cape Sable seaside sparrow, the Everglades Snail kite, the Florida panther, manatees and wood storks. A better understanding of the increase in resilience of a restored Everglades freshwater and coastal ecosystem to climate change and sea level rise will help us better plan and implement similar restoration options as we assist natural systems in adapting to climate change.

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The Challenges of Stakeholder Engagement in the Missouri River Recovery Program

Mary Roth

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The Missouri River Recovery Program (MRRP) purpose is to restore a portion of the Missouri River ecosystem and habitat for fish and wildlife, while maintaining the congressionally authorized uses of the river. Initiated in 2006 by the US Army Corps of Engineers and US Fish and Wildlife Service, the Program's mission is to implement actions to accomplish Missouri River ecosystem recovery goals in coordination and collaboration with agency partners and stakeholders.

By Congressional authorization, the Corps constructed what now constitutes two major projects on the Missouri River. The Missouri River Mainstem Reservoir System (Mainstem Reservoir System) and the Missouri River Bank Stabilization and Navigation Project (BSNP). These two major projects highly altered the flows and habitat that once comprised the natural Missouri River. The mandate and authorizing legislation require the Corps to find a balance among competing needs and uses of the river by concerned governmental entities and stakeholders. The BSNP Fish and Wildlife Mitigation Project in the Water Resources Development Act (WRDA) of 1986, as modified by WRDA 1999 authorized the acquisition and development of 166,750 acres of fish and wildlife habitat along the channelized portion of the Missouri River. The U.S. Fish and Wildlife Service (USFWS) completed its 2000 Biological Opinion (BiOp), which was amended in 2003, that addressed the recovery of the listed threatened and endangered species on both the Mainstem Reservoir System and the BSNP, on the Missouri River.

Section 5108 of the Water Resources Development Act of 2007 authorized the Secretary of Army to establish a committee to be known as the Missouri River Recovery Implementation Committee (Committee) for the purpose of providing guidance on the Missouri River Ecosystem Restoration Plan and the Missouri River recovery and mitigation plan. The Committee membership includes multiple Federal agencies, twenty-eight sovereign Tribal nations, eight states and a large number of diverse interest groups and organizations. The stakeholder participation in the Missouri River recovery effort is essential in order to ensure that public values are incorporated into the decision process.

Although the Committee's achievements have laid a firm foundation for very important work on the Missouri River in coming years, several constraints have become evident. The diverse membership has myriad reasons for joining the committee. This has created a lack of a singular vision for what the committee is to accomplish, resulting in lost time and effort, disgruntled participants, and frustrated agency personnel. The long-standing divides between basin residents and federal agencies have fostered many "us against them" dynamics. There is a fundamental lack of understanding of collaborative processes (including third-party-neutral facilitation) and a deep entrenchment of positions that has been challenging to overcome. The recovery program was functioning prior to the development of the implementation committee. Incorporating a collaborative body into a functioning program is an ongoing challenge that includes changing agency attitudes.

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Culvert Retrofit and Stream Channel Restoration to Insure Fish Passage along Fond du Lac Creek, near Cloquet, MN

Laura L. Rozumalski¹, Martin T. Kuhn² and Mark S. Riedel¹

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Fond du Lac Creek is a state designated trout stream in northeastern Minnesota and once had a diverse fish assemblage, including both stocked and naturally reproducing brook trout. The creek is located on the Fond du Lac Band of Lake Superior Chippewa Reservation and served as a popular fishery for Band members in past decades, providing an important cultural and subsistence resource for the tribal community. Fisheries assessments of this stream over the past five summers have yielded few or no brook trout, indicating a seriously impacted resource. Roadbed reconstruction in the late 1970's resulted in grading a steep embankment for the Reservation Road crossing over Fond du Lac Creek and the corrugated steel culvert installed at the crossing was improperly aligned with the stream bed. Currently, the downstream end of the culvert is perched approximately two feet above the water level during normal flows. This poorly installed culvert is perched too high to accommodate fish passage and maintain the hydrologic connection to the St. Louis River. Aside from this obvious physical impairment, however, monitored habitat quality and water quality parameters indicate a relatively healthy coldwater stream ecosystem, supporting diverse macroinvertebrate and fish communities. Here, we will present alternatives for modifying the road crossing to insure fish passage and discuss which approach would be most beneficial. Design alternatives include culvert retrofit or complete culvert removal in conjunction with channel and floodplain restoration. This project is being done in partnership with the US Army Corps of Engineers with support from the Fond du Lac Reservation Environmental Program.

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Terrebonne Basin Marsh Restoration: Challenges in Louisiana Coastal Area Ecosystem Restoration

John Peukert and Kip Runyon

US Army Corps of Engineers, St. Louis, MO, USA

As part of the Louisiana Coastal Area Ecosystem Restoration Program, the U.S. Army Corps of Engineers St. Louis and New Orleans Districts recently completed a feasibility study to determine the best course of action for restoring marshes in the Terrebonne basin of coastal Louisiana. The Terrebonne marshes are located 50 miles southwest of New Orleans near the City of Houma, LA. Marshes in the area are disappearing at an accelerated rate due to the combined effects of subsidence, sea level rise, erosion, saltwater intrusion, and a lack of adequate sediment and nutrient deposition. Without intervention, approximately 20% of the existing marshes in the 700,000-acre study area are projected to be lost by the year 2065. In order to reduce this trend of marsh loss, the study team considered a wide range of measures including diversion of freshwater flows from the Atchafalaya River; dredge channels, water control structures, berms, and channel plugs to more efficiently convey existing and additional fresh water flows; and marsh creation features. The recommended plan is a complex combination of these measures that is projected to reduce the rate of land loss over the period of analysis by approximately 10,000 acres.

The study presented many unique challenges for the interagency team. The need for increased freshwater flows was hampered by the requirement to prevent any increase in flood stages for area residents or for marshes that already receive adequate or surplus flows. The complex hydrology of the large study area required the development of an extremely large hydraulic model that was used to determine project benefits and ensure that critical infrastructure and habitat were not negatively impacted by increased stages. The scale of the study area and the lack of any significant sediment carrying capacity of area waterways precluded landbuilding through sediment transport. Instead, the plan relies on enhanced organic deposition through increased nutrient transport. These obstacles, in combination with a congressionally-mandated timeline, proved challenging to overcome. The recommended plan does not solve the problem of land loss in the Terrebonne Basin, but provides a critical first step toward restoration of a nationally significant ecosystem.

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Local Government Contributions to Chesapeake Bay Ecosystem Restoration

Andrea Ryon and *Fernando Pasquel*

Michael Baker, Jr. Inc, Alexandria, VA, USA

The Chesapeake Bay is the largest estuary in the US, with a watershed that covers 64,000 square miles and a population of 17 million people within six states. Excess nutrients and sediments have long been understood to be the primary source of Bay degradation and cooperative efforts to resort the Bay have been ongoing since the first Chesapeake Bay Agreement was signed in 1983.

Many local governments in the Chesapeake Bay watershed have developed robust stormwater programs to manage pollutants from urban sources within the Chesapeake Bay watershed. With the issuance of the Chesapeake Bay TMDL and development of Watershed Implementation Plans (WIPs), these local governments are planning and implementing additional widespread solutions to support the Bay.

The stormwater programs' many elements that contribute to the ecosystem health of the Chesapeake Bay include Stormwater Best Management Practices, such as **Site or development level** - Small-scale, decentralized controls and site planning to mimic pre-development hydrology as well as urban stormwater retrofits; **Watershed level** - Assessment, monitoring, evaluation, alternative analyses and regional controls; and **Streams and aquatic habitat** - Stream restoration, channel protection, buffer establishment; as well as the following components: **Funding** - Addressing the challenge of funding; **Policy and Guidance** – Guidance to help developers and others implement projects and conduct ongoing maintenance; and **Tracking and Reporting** – Methods for assessing progress

This presentation will provide specific example case studies of solutions implemented via several local programs and a discussion of the coming challenges they face in integrating their restoration programs with the Chesapeake Bay TMDL and upcoming stormwater NPDES permit requirements.

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Platte River Recovery Implementation Program: Real Estate Methods of a Willing Buyer Willing Seller Acquisition Program

Bruce K. Sackett

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A primary goal of the Land Component for the Platte River Recovery Implementation Program (PRRIP) is to restore more 10,000 acres of habitat in the Platte River corridor from Lexington, Nebraska to Chapman, Nebraska for creation of habitat complexes able to be used to measure and restore natural habitat conditions for three threatened and endangered avian species – interior least tern, piping plover, and whooping crane. Headwaters Corporation, a private corporation formed at the request of the Three State Agreement Governance Committee made up of Colorado, Wyoming and Nebraska; the Department of Interior; upstream and downstream water users, and conservation groups form the decision making body of the Program. However, Headwaters Corporation, a private consulting firm, provides the Executive Director and staff for the Program and is responsible for negotiating land rights and presenting private offers to sell for approval by the Governance Committee of the PRRIP. The unique public/private mix of willing private sellers negotiating through a private corporation to sell fee simple title to a trustee representing three states and the Bureau of Reclamation is a one of a kind creation in restoration programs. Additional Water and Adaptive Management components make up the other two parts of the PRRIP. In three years work 80% of the land goals are now completed. The first increment period lasts through 2019.

Techniques used are a combination of tools and negotiation methods learned from almost 40 years of public and private real estate transactions. A key to the success of this process has been the extra effort forged into the process of forming this public private program. Landowner input, the desire to hold property in trust not alone in the hands of any one agency, paying the same tax rate as other private landowners, establishing a good neighbor policy, being proactive toward potential conflicts, and focusing management into a swift but responsible managing entity made the needed steps toward acceptance in the community.

The rapid completion of land objectives has added credibility to the entire program and given an opportunity to get projects going on the land and provide early results to allow more time to learn about the needs of the three species. Water needs and adaptive management can be focused on as the final properties are purchased. The gathered data can then be used to support the ultimate goals of the program entering into a second increment after 2019, providing discussion for additional acres of land and management presently held by nongovernmental and governmental agencies.

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Stream Daylighting and Restoration in the Indiana Dunes State Park and National Lakeshore

Dan Salas and John Richardson

Cardno JFNew, WI, USA

JFNew, working with the Troyer Group, designed the project to restore 900 feet of Dunes Creek and adjacent wetlands that had been under a parking lot since the 1930's. The project was implemented to improve water quality that flows from Dunes Creek into Lake Michigan at the public bathing beach. To accomplish these goals, nearly 800 lineal feet of Dunes Creek was daylighted and restored to match historic accounts of the channel and the current surrounding conditions. In total, approximately one acre of concrete and 10,500 cubic yards of sand fill were removed to restore this natural, sand-bottom stream. To assess the success of the restoration, the biotic community within the stream was sampled upstream and downstream of the restored section of Dunes Creek in the spring preceding and two years following restoration efforts.

The park has experienced annual flooding and deterioration of the parking lots in recent years, increased maintenance costs of sand removal from dune migration, increasing bacterial contamination, and biotic impairment of the stream. These concerns lead to the removal of at least one acre of parking area and restoration of the stream channel, floodplain, and riparian wetlands.

The Indiana Department of Natural Resources was awarded a Conservation and Native Landscaping Award for their restoration work of Dunes Creek at Indiana Dunes State Park. The award, sponsored by the U.S. Environmental Protection Agency and Chicago Wilderness, recognizes park districts, municipalities and corporations that make extensive and creative use of native landscaping to support native species, as well as support biodiversity and ecological restoration. This project was also awarded the Governor's Awards for Environmental Excellence in Indiana, and an Engineering Excellence award from the Association of Conservation Engineers.

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Urban Coastal Wetland Restoration Planning in America's Birthplace: Lessons from the John Heinz National Wildlife Refuge and 300 Years of Urbanization

Dan Salas

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Ecological assessment and planning is the first step toward efficient ecosystem restoration. This session will discuss the series of planning efforts completed by the USFWS and JFNew to identify management priorities and the restoration focus for the last remnant of freshwater tidal marsh in Pennsylvania, and its surrounding Coastal Plain natural communities.

The John Heinz National Wildlife Refuge at Tinicum, managed by the U.S. Fish and Wildlife Service, contains a diverse mix of ecosystems including freshwater tidal wetlands, non-tidal wetlands, riparian forests, open meadows, a large tidal river, and open water impoundment. Climate change, sea level rise, invasive species, overabundant deer populations, and public use are some of the issues the John Heinz NWR has addressed in its planning efforts to date.

Under its current development of its Comprehensive Conservation Plan, a strategic plan for the entire refuge over the next fifteen years, the refuge is charting its path for future restoration efforts. The integrated planning effort combines historical research, landscape conservation context review, GIS analysis, sea level rise modeling, personal interviews, stakeholder feedback, field research, and data management in combination with USFWS policies on habitat management and climate change.

This session will provide an overview of this process and focus discussion on the coastal wetland restoration planning component of these efforts. This process involved review of regional conservation priorities, historic conditions, ecosystem resilience, and field data collection. This information was compared with review of current and future impacts likely to affect the area targeted for restoration, including the application of SLAMM (Sea Level Affecting Marshes Model) to project the local implications of sea level rise.

The methods and results of this project provide a case study for other restoration and conservation planning efforts for large and diverse sites. Aspects of the planning process are discussed in an article published recently in the *Journal of Ecological Restoration*.

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The Loxahatchee River Watershed Restoration Project: Restoring Wild and Scenic Florida

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Authorized by the Water Resources Development Act (WRDA) 2000 as a component of the Comprehensive Everglades Restoration Plan (CERP), the Loxahatchee River Watershed Restoration Project (LRWRP) has amongst its objectives the goal of restoring natural freshwater flows to the Northwest Fork of the Loxahatchee River (NWFLR). In 1985, 7.1 miles of the NWFLR, located in Jonathan Dickenson State Park, were federally designated as National Wild and Scenic River. As one of only two National Wild and Scenic Rivers in the state of Florida, the NWFLR supports one of the last remaining vestiges of old growth cypress swamp in the nation. This freshwater floodplain habitat contains bald cypress up to 500 years old interspersed amid hardwood hammock and riverine habitat providing a unique environment that is home to numerous listed species including the wood stork, the red cockaded woodpecker, the eastern indigo snake, and the Florida panther. The natural river channel originates in the Loxahatchee Slough to the south and flows northeast to the Loxahatchee estuary. In the 1950s, flows within the Loxahatchee Slough were channelized and primarily diverted out the Southwest Fork of the Loxahatchee River for drainage and flood control purposes, severely reducing the seasonal freshwater flows to the NWFLR. In the 50 years since, the reduced freshwater inflow have allowed the saltwater wedge to move upstream into the once pristine freshwater floodplain. The freshwater system is now exhibiting shifts in the vegetative community resulting in mangrove encroachment and cypress mortality.

The LRWRP proposes a series of structural and operational changes to the existing canal system upstream of the NWFLR. These changes will increase inland freshwater storage and allow for operational control of the timing and delivery of freshwater flows to the NWFLR to meet the ecological needs of the river system, allowing for the recovery and lasting sustainability of this unique and federally designated habitat that is a valued ecological resource both for the state of Florida and the nation.

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Integrated Flood Risk Management and Ecosystem Restoration on McCormack-Williamson Tract with the California Department of Water Resources and The Nature Conservancy

Brooke Schlenker

U.S. Army Corps of Engineers, Sacramento, CA, USA

Panel Overview:

The Bay-Delta is California's hydraulic heart with very valuable, but fragile ecosystem, conveyance, and flood systems. Despite significant Federal spending and a comparable State share over the past 15 years, the ecosystem has continued to deteriorate. Continuation along the same path is not a viable option. The risks remain real – imperiled water supply for 25 million residents, scant irrigation water for 9 million acres of the nation's most productive farmland, and threatened critical energy and transportation infrastructure that supports the 8th largest economy in the world. In addition, there are fifty-five (55) ESA-listed species in the Delta. These risks transcend the California legal Delta boundaries, and they need to be considered as part of an overall system that encompasses natural and engineered waterways, regional environmental health, public safety, and national, regional and local economic livelihood. One must also consider the political context created as a result of Federal, State and local government responsibilities and the myriad of interested stakeholders.

Presentation Summary:

Ms. Brooke Schlenker, Water Resources Planner at the US Army Corps of Engineers Sacramento District, will be the fourth speaker in a moderated panel discussion entitled "A Systems Perspective on Addressing Water Resources Challenges in the Sacramento – San Joaquin Bay Delta," providing the applied perspective.

The California Bay-Delta is the largest estuary in the western United States, yet less than five percent of the original tidal marsh that once defined the Delta remains. Rather than marshland, Delta waters now flow through a series of channels constrained by levees which disconnect the reclaimed wetlands from flowing water. As the last of the islands in the immediate area to be reclaimed, McCormack-Williamson Tract's potential to increase flood risk to adjacent islands resulted in a legal agreement to ensure that the McCormack-Williamson Tract levees would be lower than those of any of the adjacent islands; in other words, McCormack-Williamson Tract would flood first. This fact made the tract less appealing for development and ultimately led to a purchase of the land by The Nature Conservancy. This presentation will provide an overview of plans being developed by the California Department of Water Resources, The Nature Conservancy and the U.S. Army Corps of Engineers to restore habitat function and reconnect the floodplain while providing improved flood risk management to surrounding islands, achieving multiple (and often times opposing) objectives and benefitting Federally listed species such as the Chinook salmon.

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Restoration of Burrowing Mayflies (*Hexagenia* spp.) in the Laurentian Great Lakes

Don W. Schloesser

USGS, Great Lakes Science Center, Ann Arbor, MI, USA

One goal of the Great Lakes Water Quality Agreement between the United States and Canada is to restore ecosystem health to international waters of the Laurentian Great Lakes. This legislation was established in response to decades of pollution that negatively impacted ecosystem components. One such component was the mayfly, *Hexagenia* spp. that disappeared from many nearshore waters of the Great Lakes in the 1950s. Mayflies disappeared in response to low oxygen caused by nutrient enrichment, subsequent growth of fertilized plants, and decomposition of plant tissues as they settled to bottom substrates where mayflies live. In response to decades of nutrient enrichment, waste water treatment was initiated in the 1970s and scientists have been looking for signs of mayfly restoration ever since.

Then in 1992, adult mayflies were observed in open waters of western Lake Erie. In 1993, the USGS's Great Lakes Science Center repeated a benthic survey performed in the 1930s, 1960s, and 1980s and verified the presence of mayflies in Lake Erie. Sporadic surveys between 1995 and 1999 revealed mayfly populations at abundances similar to those found in the 1930s (ca.400/m²). These populations were annually unstable but adult emergences become so abundant they disrupted electrical power generation, created slippery roads and automobile hazards, impacted tourism, and discouraged recreational use of the lake. In 2000, USGS initiated systematic surveys specifically designed to assess mayfly restoration in Lake Erie.

Surveys reveal a cycle of mayfly abundances that resemble a 'boom-and-bust' pattern of an organism that reproduces until it is limited by some environmental factor which causes a sudden 'crash' in abundance to occur. To date, data reveal three, four-year cycles of high abundance followed by a sudden decrease in abundance. This has led to a working hypothesis that mayfly populations in western Lake Erie are partially 'self-regulating.' The mechanism behind self-regulation is hypothesized to be one where mayfly respiration contributes to low oxygen concentrations still being caused by 'residual' pollution. In some years, oxygen use by residual pollution and mayfly respiration causes low oxygen and subsequent mortality of mayflies and other benthic populations. Separate studies have shown failed young-of-the-year mayfly recruitment possibly in response to low oxygen. In addition, the presence mayfly respiration may increase oxygen demand by a factor of 2.5 and account for up to 70% of the total oxygen consumed near bottom sediments. These results confirm the relationship between oxygen use by mayflies and the potential for a density-dependent mechanism limiting mayflies in western Lake Erie. Continued surveys, further laboratory testing of the density-dependent hypothesis, and verification of oxygen models will reveal when mayflies will be totally restored to Lake Erie. If the density-dependent hypothesis is proven correct, inclusion of respiration by benthic fauna into widely used eutrophication models to monitor pollution abatement could improve understanding of lake restoration efforts in Lake Erie, the Great Lakes, and other water bodies throughout the world.

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Restoration Options for Neotropical Migratory Birds: a Look Toward the Future

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The National Resource Damage and Restoration (NRDAR) program has resolved hundreds of natural resource damage cases, collected hundreds of millions of dollars for natural resource compensation, and protected hundreds of thousands of acres of wildlife habitat. Many of these cases have involved migratory bird species that require an array of habitats in geographically disjunct areas to complete their life cycle. Restoration of these species through NRDAR projects have largely targeted the geographic locales where environmental injury was incurred. Precedents for applying (at least some portion of) restoration efforts on geopolitically distinct units far removed from impact sites exist; however, these cases are relatively few, and have been restricted to cases of seabirds, shorebirds, and waterfowl injured by oil spills. Given that more than half of the bird species that breed in temperate North America spend most of each year on Neotropical over-wintering areas, we urge future NRDAR projects aimed at migratory bird restoration to consider opportunities for restoration outside of areas directly affected by the environmental injury.

The importance of over-wintering habitats in driving the demographic rates, population dynamics, and trends of migratory birds is becoming increasingly apparent, suggesting that conservation and restoration applied to these areas would be especially effective in offsetting injury. Here we (1) provide a framework for assessing costs and benefits of restoration at various geographic locales used by migratory birds throughout their life cycles and (2) suggest information needs for guiding effective restoration and conservation of migratory birds on their wintering grounds. To illustrate, we present a case study that explores restoration options for forest birds at a site in Virginia affected by mercury contamination. We leverage a variety of data to identify and assess restoration opportunities, including broad-scale monitoring data collected by a diverse group of volunteers, non-profit conservation groups, and professional biologists. We use our example study to highlight challenges and practical issues surrounding successful implementation and evaluation of international restoration collaborations.

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Low-Flow Model for Tres Rios Environmental Restoration, Phase 3A

Heather E. Schwar, Michael T. Schwar and Michael A. Hrzic

HNTB Corporation, Milwaukee, WI, USA

The Tres Rios Phase 3A environmental restoration project is located along the Gila River from the downstream edge of Old 115th Avenue to the Gila River/Salt River confluence, and along the Salt River from the confluence to approximately 107th Avenue. In general, the project includes the grading of open water, wetland marshes and other habitat areas along the project reach within the active stream system. Work includes plant removals within the project limits and revegetation with native plant materials. Incidental related work includes, in part, construction of storm drain culverts and stabilization measures along Old 115th Avenue.

The near-surface groundwater is considered the only reliable water source. If the vegetation communities are established at elevations where they can use groundwater to supply their water demand, the peak demand would require 5 inches of groundwater per month during June through August, and 2.7 feet per year. Existing groundwater levels were explored by potholing in October 2010. These were found to be generally within one foot of the proposed design low water levels. In addition, the area within the 2-yr floodplain groundwater levels would be replenished on a regular basis by infiltrated overbank flows.

It was determined that grading should be established to create an additional side channel while retaining normal water levels at the current level of 929 ft to meet the project constraints. An existing natural rock feature provides a hydraulic control that maintains an upstream-to-downstream water level difference of approximately two feet. Alterations to the grading plan were required to eliminate excavation of this feature and to provide a constriction that maintains this hydraulic condition.

A HEC-RAS hydraulic model of the proposed grading plan was developed to evaluate design flows through the project area to evaluate velocities, water depths, and potential deposition conditions and to evaluate the over-topping of Old 115th Avenue during low-flow conditions. The development of the low-flow model and how the model affected the overall design of the system and its operation and maintenance will be discussed.

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Implementing Riparian Ecosystem Restoration Using a Design-Build Framework: Tres Rios Ecosystem Restoration Project Phase 3, Phoenix AZ

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The U.S. Army Corps of Engineers Los Angeles District and City of Phoenix, AZ, are implementing Phase 3 of the Tres Rios Ecosystem Restoration Project through a design-build contract with Kiewit Western Co. This project extends approximately 5.2 miles in length and one-mile in width, along the Gila River, initiating in the vicinity of the confluence with Salt River and terminating just upstream of the Agua Fria River confluence. Project objectives include:

- Restoring and creating conditions for sustainable riparian habitat
- Creation of a complete and diverse riparian system similar to that historically represented in the area,
- Reducing flood damages, and
- Providing environmental education and passive recreation opportunities incidental to restoration.

Kiewit, along with its design team led by HNTB and Logan Simpson Design Inc., was responsible for taking the 90% design provided in the request for proposal for the initial section (Phase 3A) to a final state and for identifying improvements and/or concerns with the provided design. The contractor team, the USACE and the project sponsors entered into a partnering process which allowed a discussion of project betterments to reduce construction costs, improve ecosystem function and/or meet additional stakeholder needs. Within a relatively short timeframe the partnering process was able to generate an alternative configuration that was well supported by project stakeholders, was deemed to be more ecologically “robust” and was significantly less difficult to construct. This paper will discuss the process undertaken to move this project to construction as well as specific restoration-related features of the project, illustrated with photos of the ongoing construction.

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Evaluation of Environmental Benefits for the Louisiana Coastal Area (LCA) Small Diversion at Convent/Blind River Project with the Wetland Value Assessment (WVA) Methodology

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The Louisiana Office of Coastal Protection and Restoration (OCPR) and the New Orleans District of the United States Corps of Engineers (USACE) proposes to construct a small (3,000 cfs) diversion project in the vicinity of Romeville, Louisiana to convey freshwater, nutrients and sediment from the Mississippi River to Maurepas Swamp and the Blind River. The Mississippi River levee system has cut off Maurepas Swamp and the Blind River from the natural periodic, near annual flooding by the Mississippi River and past construction of logging trails, drainage canals, pipelines and other utilities, and roads through the swamp have disrupted the natural flow and drainage patterns, and impacted the biological productivity of the swamp. The goal of the project is to reintroduce freshwater, nutrients and sediment to this bald cypress-tupelo swamp to increase biological productivity and rebuild wetlands at a rate greater than the subsidence rate and reverse the trend of deterioration of the swamp. Reversing the trend of deterioration will help to develop a more sustainable wetland ecosystem which can serve to protect the local environment, economy, and culture. The Wetland Value Assessment (WVA) methodology was used to evaluate environmental benefits for project alternatives for selection of a preferred alternative. Environmental benefits are quantified in the WVA in terms of Average Annual Habitat Units (AAHUs) for a 50-year period of analysis. The field methodology in support of the WVA, the WVA analysis, and the results of the alternatives analysis will be discussed.

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Assessment of Goods and Valuation of Ecosystem Services (AGAVES) in the San Pedro River Basin, Arizona and Mexico

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A consortium of Federal, academic, and non-governmental organization (NGO) partners have established a collaborative research enterprise in the San Pedro River basin of southeastern Arizona and northern Sonora, Mexico, to develop methods, standards, and tools to map, assess, and value ecosystem services. The primary objective of the AGAVES project is to understand, model, and predict the consequences of natural and human-induced change on ecosystem services in semiarid regions, in order to improve resource management and decision-making. This will be accomplished through a long-term, integrated program of observation, process research, modeling, assessment, and integrated valuation using both existing and innovative technologies. The project will be sustained by close cooperation and coordination among scientists and decision-makers.

Water is the limiting resource in the semiarid San Pedro basin. The remaining perennial reaches of the San Pedro river support a desert riparian ecosystem that is a rare remnant of what was once an extensive network of similar riparian systems throughout the Southwest, and is thus of critical ecological and cultural importance. This ecosystem is protected by the Nation's first Riparian National Conservation area, but the groundwater that is critical to sustaining flow in the San Pedro is also the only source of water presently available to support human communities, which use more than is being recharged. Climate change and population growth are expected to reduce recharge and increase demand in the basin, compounding the problem. A systematic and comprehensive analysis is required to fully understand the implications of management and policy actions for the basin's communities and ecosystems.

An ecosystem services approach has been adopted to identify the costs and benefits associated with scenarios based on different combinations of stressors. Alternative future scenarios based on climate change, urbanization, and water augmentation by extending the Central Arizona Project canal, which provides Colorado River water to Tucson, will be compared relative to stakeholder requirements and the monetary and non-monetary value of ecosystem goods and services preserved or lost.

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CANCELLED ABSTRACT

The Monarch Joint Venture: Building a National Restoration Program to Protect the Monarch Migration and Pollinator Habitats

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Every year, the North American monarch butterfly completes an astonishing multi-generational migration from overwintering sites in central Mexico and coastal California to their breeding grounds throughout the eastern U.S., southern Canada, and portions of the inland Western U.S. Over the past several decades, monarchs and this migration have been the focus of increasing conservation concern. In 1983, the International Union for Conservation of Nature listed their migration as an endangered phenomenon, making this the first-ever biological phenomenon to gain conservation status. Just last year, the World Wildlife Fund included monarchs, together with species such as polar bears, walrus and tigers, on their list of “10 to Watch in 2010”: all species thought to be highly threatened, and in need of conservation remedies.

The Monarch Joint Venture, a partnership of federal and state agencies, academic programs, and conservation NGOs, is working to build conservation efforts focused on increasing breeding habitat for monarchs throughout the United States, including habitat restoration and enhancement efforts that bring milkweeds and late-blooming nectar plants to the landscape. Threats to monarch overwintering habitat in Mexico garner much attention, but the monarch also suffers threats from breeding habitat loss in the United States and Canada, and increasing temperatures that influence timing and overall ability of milkweed and nectar resources. Monarchs depend upon milkweed for their caterpillars to grow and develop, and nectar resources to fuel adult butterflies in their travel and reproduction. Fortunately, monarchs do not use specialized habitats; rather, they use open spaces, fly great distances, and can find the resources they need - milkweeds, nectar sources, and shelter - if they are present.

Here we share the efforts of the Monarch Joint Venture and its partners to build a national restoration program focused on protecting monarchs and other pollinators, including identification of priority milkweed and nectar plant species, efforts to build commercial availability of needed plant resources, and engaging restoration partners to include native milkweeds and other nectar plants in their restoration projects where appropriate. In addition to the key role that milkweeds play in monarch growth and development, they are also a very valuable nectar resource for a wide variety of pollinator species, including bumble bees, mason bees, and other important providers of crop- and native plant pollination services. Monarchs further share their habitats with a large number of other organisms that benefit from the fruits, nuts, berries, seeds and foliage that are a consequence of pollination. By restoring habitat for monarchs, we will provide resources and create habitat for many additional species, and help to bolster the valuable pollination services upon which our ecosystems depend.

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Interagency Monitoring of Bighead and Silver Carp in the Upper Illinois River and Chicago Area Waterways

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Bighead and silver carp (Asian carp) have expanded their range since they first established feral populations in Arkansas in the early 1980's. By the mid 1990's, naturally reproducing Asian carp were found throughout much of the Mississippi River and in its larger tributaries. One of these tributaries, the Illinois River, is connected to Lake Michigan through a series of locks, dams, canals and rivers known as the Chicago Area Waterways (CAWs). Some scientists believe that Asian carp will threaten the biodiversity of the Great Lakes and its tributaries and that the CAWs are the most likely entry point. The U.S. Army Corps of Engineers is responding to this threat with the construction of three large electric dispersal barriers in the CAWs at Romeoville, Illinois. Two of these barriers have been constructed and are in operation; creating water borne electrical fields capable of deterring fish movements upstream of the barrier toward Lake Michigan. An interagency collaborative effort was also undertaken to develop and implement a Monitoring and Rapid Response Plan (MRRP) to ensure the barriers were working effectively.

This presentation focuses on the development, implementation, and findings of the MRRP from 2009-2010. The project area included over 200 miles of waterways surrounding the electric dispersal barriers. The MRRP was developed by biologists from state and federal agencies, and academia as a science-based approach for evaluating the presence, abundance, and threat potential of Asian carp. This plan called for the use of a variety of monitoring techniques that included; electrofishing; netting; hydroacoustics surveys; telemetry; and eDNA. The MRRP also included response actions to be taken to validate monitoring results which included extensive and rapid deployment of commercial fishing and the application of the fish toxicant rotenone. Between June and September 2010, a total of 36,174 fish from 64 species and 4 hybrid groups were recovered as a result of monitoring efforts guided by the MRRP. In addition, over 100,000 fish from 38 species and 2 hybrid groups were recovered from response actions including two rotenone applications covering 8.4 miles of waterways. One bighead carp was discovered immediately below the dispersal barriers during a rotenone treatment in December 2009 and another was recovered from Lake Calumet, upstream of the barriers, during netting activities in June 2010. The overall result of the collaborative efforts undertaken to date has been a better understanding of the dynamics of Asian carp within the upper Illinois Waterway and the CAWs in addition to monitoring the effectiveness of the electric dispersal barriers.

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Restoration of Longleaf Pine - Slash Pine Ecosystems in Flatwood Habitats of Florida: Effect of Management Systems and Species Composition on Understory Light Availability

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Restoration of longleaf pine-slash pine ecosystems is currently the goal of significant restoration efforts in the south-eastern United States. These ecosystems with high species richness, mainly contributed by understory, once occupied an estimated 37 million hectare in the south-eastern U.S. and are now reduced to a fraction of their original extent mainly due to conversion to other commercial pines and fire-exclusion. Understory light regime is one of the most important ecological factors affecting restoration, sustainability and maintenance of diverse understory in these ecosystems. We studied understory light availability in these ecosystems in various sites in north-west and north-central Florida managed under different uneven-aged systems using Digital Hemispherical Photography. Different management systems including single tree selection, group selection, uniform shelterwood, and irregular shelterwood systems differed in understory light availability in terms of gap fraction, fraction of Absorbed Photosynthetically Active Radiation and Leaf Area Index. The stands under observations ranged over basal area of 4.5 m²/hectare to 45 m²/hectare whereas the overstory species composition ranged from pure longleaf pine to pure slash pine as well as mixed stands of these species in varying proportions. A curvilinear relationship was observed between basal area and understory light availability wherein understory light availability decreased with increasing basal area of the stand. The overstory species composition also affected understory light availability and the effect was more pronounced in stands with lower basal area. In general, for a given basal area, longleaf pine showed greater understory light availability than slash pine.

The slash pine- longleaf pine ecosystems in the coastal plains of the south-eastern United States are being restored and managed under basal area regulation approach. Under this approach, generally, residual basal area prescriptions are made without regard to the overstory species composition in the mixed stands. However, as the study has suggested, the understory light availability is affected by the proportion of constituent species in the overstory in the mixed stands. Thus, basal area regulation approach must account for overstory species composition so that optimum light regimes could be created while restoring and managing these ecosystems.

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Analysis of Implementation and Governance of Large-Scale Ecosystem Restoration Initiatives: A Congressional Perspective

Pervaze A. Sheikh and *Charles V. Stern*

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The United States has committed billions of dollars towards restoring large-scale ecosystems such as the Great Lakes and the Everglades. The implementation and governance of these initiatives varies and are often tested by conflicting interests and changed circumstances. Congress provides oversight on these initiatives, often questioning how restoration activities are implemented, the progress of restoration, the use of funds, and the effectiveness of governance, among other things. To inform policy debates, a study of legislatively relevant policies in 16 large-scale ecosystem restoration initiatives was done. The policies include leadership of initiatives, decision-making entities and structures, funding arrangements, stakeholder participation, oversight and monitoring, adaptive management, and use of science, among others. This information frames a discussion of the potential benefits and drawbacks of selected policies associated with large-scale ecosystem restoration initiatives. Further, a set of lessons learned for selected policies is also presented. These lessons were based on the discussion of potential pros and cons of policies, informal interviews with restoration managers, and a review of literature and legislative proceedings. The findings of this study aim to help decision-makers, stakeholders and legislative bodies enhance existing large-scale ecosystem restoration initiatives and shape future initiatives around the world.

Disclaimer: The views expressed herein are those of the author and are not presented as those of the Congressional Research Service or the Library of Congress.

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Components of the Chesapeake Bay TMDL

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Due to the unprecedented scale and other unique characteristics of the Chesapeake Bay TMDL, novel approaches to many of the critical elements of a TMDL were required. These approaches benefitted from collaboration and joint decision making by EPA and its partners, which included state, local, academic, and private organizations.

The vast amount of observed data available in the Chesapeake region allowed a choice of hydrologic period for model application. A ten-year period was selected based on analysis to determine a common representative period over areas of the watershed. The definition of critical conditions relied on an examination of hydrologic and water quality data to find a condition with an appropriate probability of recurrence.

The Chesapeake TMDL required finding loads of nitrogen, phosphorus, and sediment that would simultaneously meet water quality standards at in 92 tidal segments with multiple standards for each water quality parameter of dissolved oxygen, clarity, and chlorophyll. Methods were developed to select the segments, parameters, and standards that were protective of the remaining segment, parameters, and standards.

Several temporal scales were addressed. TMDLs are required to address seasonal variation and express loads as daily values. Attainment of water quality standards are more related to annual loads, however. The modeling and water quality standards structures were able to accommodate simultaneous analysis of multiple temporal scales.

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Development and Acceptance of Knowledge Based Systems for Spatial Decision Support Systems to Evaluate Streamflow Augmentation Recharge and Waterfowl Habitat Pond Sites

Cat Shrier

Watercat Consulting LLC, Washington, DC, USA

Seasonally flooded wetland ponds in riparian areas have been recognized to perform multiple beneficial functions, including groundwater recharge, groundwater discharge to augment streamflows, and habitat for a diverse array of wildlife species, including waterfowl (e.g. Adamus et al. 1991). In the lower South Platte River Basin of Colorado, managed groundwater recharge ponds have been developed for conjunctive management of stream-aquifer systems for streamflow augmentation during low-flow periods to off-set depletions caused by well withdrawals from alluvial aquifers, in accordance with Colorado's prior appropriation water law. Several habitat partnership programs have begun working with landowners and water user organizations in this region to include managed groundwater recharge ponds in wetland restoration efforts, and to design the ponds to provide seasonal wetland habitat, primarily for waterfowl (South Platte Wetlands Focus Area Committee Strategic Plan 2003).

By selecting appropriate pond locations and appropriately designing and operating the recharge ponds, well users can mitigate the stream depletion impacts of their pumping on more senior water rights under a prior appropriation legal doctrine. Pond locations can also be selected and evaluated for their potential to benefit waterfowl at the site, and for the development of regional wetland complexes. The cost of the pond site development is also tied to the pond's location due to such factors as the proximity and gradient to water sources and the pond site's soil profile, which impacts recharge rates and excavation costs.

The Waterfowl and Augmentation Pond Site Assessment Model (WAPSAM) was developed to combine use of knowledge-based systems, multi-criterion decision analysis techniques, and geographic information systems to develop a representation of the decision process for pond site evaluation for voluntary projects (Shrier et. al. 2008). Rule bases were developed to address recharge pond siting requirements, cost assessment, and waterfowl habitat siting assessment to support public-private partnerships and incentive programs.

The WAPSAM approach was applied again to a second project in the Rocky Mountains to support determination of requirements for compensation from a wetland "trust" or bank on the basis of wetland functions, rather than an area-based approach for replacement of impacted wetlands. The prototype model was used to review policy approaches to wetland compensation requirements.

This article reviews some of the advantages and challenges associated with the development, validation, and acceptance of knowledge-based systems, particularly as applied to wetland evaluations and water management decision support, and how these systems can support policy and planning activities by stakeholder organizations and agencies.

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A History of Agricultural BMPs Implemented in the Octoraro Creek Watershed, and Associated Nutrient Load Reductions to the Chesapeake Bay

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The Octoraro Creek drains 208 square miles in Lancaster and Chester counties in Pennsylvania and Cecil County in Maryland, and enters the Susquehanna River at the head of the Chesapeake Bay. Land use is 75 percent agricultural, largely with Old Order Amish dairy farming and swine farming. The Octoraro Creek watershed has been identified as a significant contributor of nutrients to the Chesapeake Bay, particularly nitrogen. The watershed is one of only a few watersheds that have been targeted by the Environmental Protection Agency's Chesapeake Bay Program for on-site farm inspections to review farm conservation plans and agricultural best management practices. Progress in reducing sediment and nitrogen loading to the Chesapeake Bay is critical to meeting the Bay TMDL issued by the EPA in December 2010.

The Octoraro Watershed Association has operated for 43 years with a focus on addressing protection and restoration of the Octoraro Creek watershed. Over this time, the OWA has implemented many best management practices in the watershed, primarily with Old Order Amish and English farming operations. Riparian buffers, stream bank fencing, stream crossings, stream restoration, terraces, diversions, dairy waste management systems, contour farming, and farm conservation plans have been installed and implemented throughout the watershed. The history of these BMP implementations will be reviewed, with an analysis of the funding mechanisms and project partners for successfully implementing projects, particularly on Old Order Amish farms that dominate this watershed. These findings from one of the oldest watershed associations in Pennsylvania are instructive as the Chesapeake Bay TMDL process now moves to the local municipal and subwatershed level for BMP implementations.

The improvement of local water quality and the reduction in sediment and nutrient loading to the Chesapeake Bay will be reviewed, using both modeled BMP reduction efficiencies from the March 2011 revised Bay watershed model and from local water quality monitoring over the last 10 years. Median stream nitrate concentrations from 1995 to 2004 ranged from 7.4 to 8.4 mg/L on the two branches of the Octoraro, but sometimes spike to over 16 mg/L. Nitrate concentrations are highest in the winter, when biological uptake and denitrification rates are lowest. Nitrate concentrations are similarly elevated in groundwater, with the Octoraro Creek watershed being the epicenter for the state in groundwater nitrate concentrations. The majority of groundwater wells have nitrate concentrations from 2.5 to 15 mg/L. These data will be updated with the winter 2011 water quality sampling. As the Chesapeake Bay TMDL process moves forward over the next 15 years, we can learn from the successes in implementing BMPs at the local watershed level and the concomitant local water quality benefits and reduced loading to the Chesapeake Bay experienced in the Octoraro Creek watershed.

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Moving the Ohio River Basin Fish Habitat Partnership from “Early Action Sites” to True “Priority Areas”

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The Ohio River Basin Fish Habitat Partnership worked with partners to identify a comprehensive list of conservation targets and strategies to address threats to those targets. This planning effort helped to identify “what” to do, but did very little to identify “where” to do it. The Partnership did identify “Early Action Sites” to focus our initial conservation efforts. These sites were areas submitted by members of the Partnership that were thought to be of high quality/importance based on professional opinion. Our next challenge was to move to “Priority Areas” that were identified through a basinwide assessment that was more scientifically defensible and more likely to result in conservation actions leading to measurable results in our targets.

The Partnership, working with other Fish Habitat Partnerships in the Midwest, contracted with Downstream Strategies to complete basinwide habitat assessments. These assessments used existing sources of data that the Partnerships deemed relevant to identify a suite of predictor variables that best described the fish, mussel, or other conservation target data. Predictor variables were categorized as either natural or anthropogenic to generate both a Natural Habitat Quality Index and an Anthropogenic Stress Index. Thus the basin could be screened for areas where habitat for one of our target species could be evaluated, first according to the natural quality, to determine if the habitat was likely to historically support the species. The second screening would identify the level of human influence to determine how well the area would currently support the species. Those areas where good natural habitat exists and human influence is relatively low were targeted for protection efforts. Those areas where good natural habitat exists and human influence is a limiting factor required further exploration to determine the likelihood that the human influence could be overcome. To complement the model, a potential future condition tool is being developed to manipulate anthropogenic stress variables. If a reasonable amount of change in one of those variables results in good habitat conditions for a target species, then those areas would be targeted for restoration efforts. In the end, these tools will allow us to better put the “right actions” in the “right places” resulting in truly effective aquatic habitat conservation.

This is one component of the proposed 4 presentations for the Ohio River Basin session.

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Implementation of a Non-structural Alternative to Levee Repair Under the Corps of Engineers' P.L. 84-99 Authority: The Green Island, Iowa, Levee and Drainage District

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A flood event during July, 2010, on the Maquoketa River in northeast Iowa, resulted in the overtopping and subsequent breaching of the Green Island Levee & Drainage District levee at two locations. When these damages were incurred, this levee system was active in the Corps of Engineers' Public Law 84-99 (P.L. 84-99) program. P.L. 84-99 provides the Corps of Engineers with authority, responsibility, and funding for the repair, or at the request of the levee sponsor, implementation of a non-structural alternative to structural levee repair, of flood damaged levees active in the program. However, if the benefit/cost ratio (B/C) of the repair is less than 1 then the sponsor's options are limited to either requesting the implementation of a non-structural alternative, with Corps funding support potentially up to the estimated cost of the structural repair, or no Federal action. In October, 2010, the Green Island L&DD, in response to a B/C ratio determination of less than 1, formally requested that a non-structural alternative to levee repair be pursued. The State's interagency flood risk management team was called upon to support this effort. It is and will continue to work closely with Corps of Engineers staff throughout the non-structural alternative identification, evaluation, and implementation process, a process that requires intensive and extensive coordination, communication, and cooperation between multiple governmental agencies and the levee system sponsors and local landowners. In the case of the Green Island L&DD non-structural alternative project significant participation by several non-governmental organizations is also expected.

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A Conceptual Ecological Model for Everglades Tree Islands

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Scientific debate surrounding tree island restoration has been contentious. As a result, development of a Conceptual Ecological Model (CEM) for tree islands, needed to direct research, develop performance measure, and set restoration targets, in comparison to other CEM's for the Everglades, has been slow. To create an adaptive management plan for tree island restoration and support hypothesis testing, a comprehensive Tree Island CEM was developed using a novel participatory modeling approach. Real-time polling of an expert audience was used to prioritize the model's linkages in terms of their ecological importance, current state of understanding and relative predictability, with each of these criteria ranked by percent agreement. Only 5 of the 30 linkages that described functional interactions between drivers, stressors and attributes were thought to be well understood by the majority of the audience. There was 80% - 100% agreement on the high importance of 11 linkages, but there was no agreement on 5 of the 30 linkages. No linkage was thought to be well understood by more than 65% of the audience, or highly predictable by more than 52%. There was consensus that hydrology and nutrients were the most important stressors and that interactions with island vegetation structure, oxidation and fire frequency, soil dynamics and wildlife use were well understood and fairly predictable. Seven of the top 10 linkages, in terms of importance, ranked in the top 10, in terms of predictability. Six such linkages involved hydrologic and soil oxidation impacts on vegetation and soils. The most predictable linkage (hydrology effects on fire) captured just 50% of all polled. Except for Link #15, for which 52% responded that the direct effect of low water on fire was highly predictable, all linkages in the CEM were rated by the majority of experts as having only low to moderate predictability. Thus, most of the experts did not believe that a high to moderate understanding of a linkage translates into the ability to quantify and predict dependencies reliably.

All of this has led to a clearer research directive and although the incorporation of a polling system into CEM development can categorize and prioritize research, using a polling system requires extensive pre-workshop preparation; including the development of well defined attributes and stressors, clear narratives for each linkage, a broad spectrum of expert participants, and a draft CEM that captures the full suite of ecological hypotheses.

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The Role of Economics in the Natural Resource Damage Assessment and Restoration Process

Kristin Skrabis and *Christian Crowley*

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The United States Department of the Interior's (Department) Natural Resource Damage Assessment and Restoration Program (Restoration Program) restores natural resources injured as a result of oil spills or hazardous substance releases into the environment. In partnership with other affected state, tribal, and federal trustee agencies, the Department evaluates injury to natural resources, including adverse effects on biota, soil, water and air. The damage determination phase of the NRDAR process establishes the necessary compensation to restore the loss of the resource experienced by the public. It includes the cost of assessing the injuries, as well as the cost of restoration. To quantify the damages, the case team may use various economic methods for determining the cumulative loss associated with the injury and the equivalent amount of restoration needed to compensate the public for the services lost over time from the injury. Economic tools used on damage assessments are described in the Title 43, Part 11 of the US' *Code of Federal Regulations*. Two restoration-based tools, Habitat Equivalency Analysis (HEA) and Resource Equivalency Analysis (REA), are commonly used in cooperative assessments and negotiated settlements. With a well-defined set of assumptions and relatively easy calculations, HEA and REA enable trustees to negotiate the extent of restoration with responsible parties while using less human capital and financial resources compared to traditional economic studies.

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Decision Making and Governance in Adaptive Management Programs – An Introduction and Platte River Case Study

Chadwin B. Smith

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The purpose of this session is to provide an overview and case studies of adaptive management program success and failure in using science learning to successfully inform management and policy decision-making. Adaptive management has been and continues to be implemented around the country and world, yet few examples exist of programs successfully implementing all six steps (Assess → Design → Implement → Monitor → Evaluate → Adjust) of adaptive management. A key break point in this process seems to be synthesizing collected data and using that synthesis to tell a story about what data say in regard to key questions and hypotheses in a way that is useful to decision-makers and results in positive changes in management or policy. This session will explore strategies used in various adaptive management programs to overcome this problem, and will showcase challenges to making science learning meaningful for decision-makers.

Adaptive management (AM) is a rigorous approach for learning through deliberately designing and applying management actions to maximize learning. AM is utilized as the science framework of the Platte River Recovery Implementation Program (Program). An adaptive management plan (AM Plan) provides guidance for Program science and offers a systematic process to test priority hypotheses and apply the information learned to improve management on the ground. The AM Plan, guided by conceptual models and multiple hypotheses developed jointly by Program partners, reflects different interpretations of river processes and species' responses to management actions. The cooperative nature of these multiple hypotheses represents a shared attempt on the part of Program cooperators and partners to use the best available science in an agreed-upon manner to implement action as experiments, learn, and revise management actions to reach a common goal – recovery of the target species.

The Program also utilizes a unique governance structure. Decision making is shared by a Governance Committee comprised of federal and state agencies, upstream and downstream water users, and conservation groups. Additionally, the Program is staffed by an independent Executive Director and staff that are not employed by any of the entities on the Governance Committee. The Program is utilizing several tools within this decision making framework to implement robust active adaptive management and attempt to generate science learning that is most helpful for making management and policy levels at the Governance Committee level.

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Proactive Solutions for America's Water Resources Needs: Planning for Tomorrow's Challenges

Chip Smith

Assistant Secretary of the Army for Civil Works, Washington, D.C., USA

Panel Overview:

The Bay-Delta is California's hydraulic heart with very valuable, but fragile ecosystem, conveyance, and flood systems. Despite significant Federal spending and a comparable State share over the past 15 years, the ecosystem has continued to deteriorate. Continuation along the same path is not a viable option. The risks remain real – imperiled water supply for 25 million residents, scant irrigation water for 9 million acres of the nation's most productive farmland, and threatened critical energy and transportation infrastructure that supports the 8th largest economy in the world. In addition, there are fifty-five (55) ESA-listed species in the Delta. These risks transcend the California legal Delta boundaries, and they need to be considered as part of an overall system that encompasses natural and engineered waterways, regional environmental health, public safety, and national, regional and local economic livelihood. One must also consider the political context created as a result of Federal, State and local government responsibilities and the myriad of interested stakeholders.

Presentation Summary:

Mr. Charles "Chip" Smith, Assistant for Environmental, Tribal & Regulatory Affairs to the Assistant Secretary of the Army for Civil Works (ASA-CW), will be the first speaker in a moderated panel discussion entitled "A Systems Perspective on Addressing Water Resources Challenges in the Sacramento – San Joaquin Bay Delta," providing the national perspective.

The Army Corps of Engineers' ecosystem restoration program has grown at a rapid pace since 1986. Mr. Smith will briefly summarize this growth, the evolution of ecosystem restoration policy, and then describe the similarities and differences associated with ecosystem restoration challenges and opportunities for the eight priority ecosystems identified by this Administration. He will touch upon the legal, scientific, economic, and social challenges associated with the eight ecosystems, and then discuss the important role of stakeholder involvement, managing expectations, and finding creative ways to address conflicts when setting ecosystem restoration goals and priorities. Mr. Smith will then focus on the California Bay-Delta Ecosystem, its importance to the Nation, its vulnerabilities, and unique challenges associated with water distributions, allocations and efforts to balance redistribution and consumptive uses with ecosystem restoration needs. The presentation will close with a brief summary of lessons learned, including the need for systems-based, Integrated Water Resource Planning for each eco-region, and for a National ecosystem restoration vision.

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Choosing One Stream Restoration Alternative Among Many

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A common challenge of stream restoration planning and engineering is determining which configuration of channel form and structures provides the greatest habitat benefit. The challenge is further complicated because determining benefit is often required before site-specific data (bathymetry, animal movement, etc.) are collected. We used the Stream Habitat Assessment Package (SHAPE) to create 3D mesh representing channel form that included structures such as double wing deflectors, rock sills, step pools, overflow areas, and outlet protection structures based on a 10% design. Using this mesh, a 3D hydrodynamic model provided information on hydraulic pattern resulting from the interaction of water movement over the channel bathymetry. We then analyzed hydraulic pattern using Eulerian-Lagrangian-Agent Methods (ELAMs) to evaluate two habitat occupancy strategies (place-searching or migratory versus place-specific or rearing). Our results indicate the five restoration alternatives for Cameron Run may provide different benefits depending on the number and placement of structures, structure type, and fish behavior but that one alternative was superior for the discharge that was simulated. The analysis allowed us to recommend one alternative over the others. SHAPE allows simulation of stream restoration projects from information available for most streams around the country (aerial photographs, discharge, cross sections) making it widely applicable. SHAPE and ELAMs also provide a representation of rivers that can be related to the principals of fluid dynamics, geomorphology, and animal sensory biology. Simulations developed using SHAPE and ELAMs are thus subject to fewer assumptions than current state-of-the practice approaches that rely on habitat units or weighted usable areas and therefore may better serve the plan formulation and plan selection in a feasibility study. There is uncertainty if this process would lend itself to benefits calculation. There may be modifications of other processes which could augment SHAPE and ELAM to make them more useful for this purpose.

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A Land of Flowers on a Latitude of Deserts: Aiding Management and Conservation of Florida's Biodiversity using Downscaled Climate Scenarios with Ecological and Hydrological Models

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La Florida (A Land of Flowers) straddles latitudes forming the northern hemisphere's desert belt. Orlando is 1° latitude south of Cairo, Egypt. Florida is unique as it is a peninsula surrounded by warm water. It also has a high biodiversity: 4,000+ flowering plants (including >700 trees); 90 mammals; 52 amphibians; 88 reptiles; 500 birds; 250+ freshwater fish. Many of these species are imperiled. How will Florida's biodiversity respond to a changing climate? Which species and habitats will increase or decrease? What role does land use-land cover change play? Answers to these questions are of critical concern to resource managers. To address these questions we are developing regionally down-scaled climate model predictions from three coupled Atmospheric-Ocean General Circulation Models (AOGCMs) for Florida and the southeastern US. The climate predictions are being used as inputs to a suite of previously developed ecological and hydrological models to assess responses of species, communities and habitats in the study region.

We first downscaled the NCEP-DOE and ERA40 re-analyses for the present (1979-2000) to assess the fidelity of the regional climate model. The downscaled climate outputs include: precipitation, temperature, winds, humidity, latent heat flux (at hourly intervals), and derived climate variables (e.g. growing degree-days, frost/freeze days, extreme heat days, wild fire potential).

This initial downscaling of the regional climate model showed that the reproduced spatial and temporal fields for precipitation and surface temperature compared favorably with station observations. Furthermore, when used in hydrological simulations, the downscaled precipitation fields result in accurate reconstruction of surface water level fluctuations in a hydrodynamic model of the Florida Everglades. Lastly, the surface temperature fields, and their variability, have been used to examine potential impacts on trust species in peninsular Florida. Considering the January and December 2010 extreme freeze events in Florida this is important as many imperiled animals suffered extreme mortality (e.g. manatee, crocodile) as did numerous tropical tree species.

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Disconnect Between Restoration Planning and Restoration Needs: Advocating a Different Timeline

Natalie Snider

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Louisiana's coastal ecosystem is complex and dynamic, while the restoration planning process tends to be stagnant and endless. The first coast-wide systematic planning effort began in 1997 and resulted in Coast 2050 in 1998. The Louisiana Coastal Area (LCA) Study, the first step in implementing Coast 2050, was completed in 2004 and authorized in 2007. In December 2010, the USACE-State partnership completed the Chief's Report on the first six LCA projects scheduled to be implemented, known as the 'LCA 6'. The next step for these projects is to undergo engineering and design. At best, the LCA 6 projects could be ready for construction in 2012, but only with an aggressive timeframe and adequate funding from Congress. More realistically, it will take another 10+ years to fund and implement all of the LCA 6 projects.

The long, tedious planning process can not adequately address the needs of the ever-changing Louisiana coast. Louisiana has lost one-third of the wetlands estimated to be lost from 2000-2050 in the first 10 years, largely due to episodic events (i.e. hurricanes, oil spills). Our science and technical knowledge is constantly improving, thus our understanding of the coast and our priorities are continuing to evolve. Planning in the 1990's may not have selected the best projects, in terms of both site selection, scale and restoration technique, for current conditions. The Coalition to Restore Coastal Louisiana, along with other partner NGOs, have worked to increase the flexibility of the planning process that allows these projects to be adapted to current conditions.

Solutions to the timeframe disconnect must be sought if we ever hope to achieve a sustainable coast. This presentation will highlight the efforts of NGOs to increase adaptability, transparency and coordination of the planning entities with NGOs and other stakeholders. The presentation will also discuss the lessons learned in the LCA project planning and steps identified to move forward more efficiently and effectively.

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Restoration of Gulf Coast Wet Prairie Habitat from Slash Pine Plantation

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Wet prairies (pitcher plant prairies, wet pine meadows, wet pine flatwoods) are unique fire-dependent wetland types that have largely disappeared from the northern Gulf of Mexico coastal landscape. It is estimated that approximately 1.2 million acres existed, of which less than 5,000 remains in semi-native state, with another 25,000 existing in degraded condition. A substantial portion of the remaining wet prairie is found in Northwest Florida, including the site of a restoration effort described in this presentation. Garcon Point in Northwest Florida has extensive wet prairie habitat protected under the auspices of the Northwest Florida Water Management District (NFWWMD), The State of Florida Department of Environmental Protection (FDEP), and Westervelt Corporation. NFWWMD holdings include the Avalon tract, an area previously planted in slash pines for private timber production. NFWWMD has implemented a cycle of regular fire to the site and removal of slash pine to restore the site to the original wet prairie state. Plant community analysis of the restoration site and a reference site, the Clark Tract, is being used to gauge the success of the restoration effort. Ten years of data have been collected on the sites that span a range of climatic conditions including extended drought, tropical storms and hurricanes with periodic management burns. The Avalon Site is moving from a highly shaded forest wetland to an open heliophyte dominated grassland. Plant community analysis by multivariate techniques show a great deal of stability in the community structure of the reference site, and significant change in the restoration site as the management strategy proceeds.

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Chesapeake Bay Oyster Restoration: The USACE Perspective- Past, Present, and Future

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USACE has been involved in Chesapeake Bay oyster (*Crassostrea virginica*) restoration since 1997. In Maryland, 451 acres of oyster reefs have been constructed in Maryland between 1997 and 2009 (202 acres for ecosystem restoration; 249 acres to benefit the fishery); in Virginia 389 acres of oyster reefs have been constructed since 2000 (149 acres for ecosystem restoration; 240 acres to benefit the fishery). In Maryland, past restoration efforts have mostly been small in scale and focused in lower salinity waters to avoid disease. Maryland restoration efforts have been mainly focused in the Chester, Choptank, Patuxent, and Severn Rivers. Virginia restoration has been undertaken in the Rappahannock River and Tangier/Pocomoke Sound, as well as on a larger scale in the Great Wicomico and Lynnhaven Rivers. Restoration in the Great Wicomico River is now six years old with healthy, abundant populations of oysters. The younger Lynnhaven project is on a similar trajectory.

USACE is developing a Master Plan that, in conjunction with the recommendations of the State of Maryland's Oyster Restoration and Aquaculture Development Plan, the Virginia Oyster Blue Ribbon Panel, and the Maryland Oyster Advisory Commission, and the Chesapeake Bay Executive Order (#13508), lays the foundation for large scale restoration throughout the Chesapeake Bay in the coming years with the goal of restoring sustainable populations to the Chesapeake Bay.

USACE's Master Plan evaluates the scale needed to restore sustainable populations, water quality under varying annual precipitation regimes, and tributary hydrodynamics in order to identify the most suitable tributaries for large scale restoration. The Master Plan will recommend a disease and reproduction strategy for future restoration that incorporates adaptive management. Specific tributary plans will be developed in follow-on plans for large-scale restoration.

Lessons learned from past restoration efforts will be reviewed as well as future needs to ensure that restoration is carried out in a cost-effective and science-based manner.

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Watershed Resources Registry: An Integrated Approach to Watershed Management

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The U.S. Environmental Protection Agency (EPA) and its partners in Maryland recognize the importance of aquatic resources for protecting the quality of waters, sustaining their aquatic life use and for providing ecosystem services. With that recognition, EPA Region III, Army Corps of Engineers, Fish and Wildlife Service, Maryland's Department of the Environment, Department of Natural Resources, State Highway Administration, Federal Highway Administration, and Charles and Prince Georges' Counties are working with partners in Southwestern Maryland to construct a Watershed Resources Registry. A targeted pilot WRR is first being developed in Maryland for Prince George's and Charles Counties, with the potential for national transferability.

The objective of the Registry is to map aquatic areas that are at risk and a priority for preservation and to identify sites best-suited for ecosystem restoration and enhancement. A major effort of the WRR process is a set of suitability analyses developed with sound science and the best professional judgment of regional experts that will be used as a screening tool to target opportunity sites for the protection of high quality resources, restoration of impaired resources, and improvement of stormwater management. The analyses will specifically identify for: upland preservation, upland restoration, wetland preservation, wetland restoration, wetland enhancement, riparian preservation, riparian restoration and, stormwater management restoration and preservation opportunities. By having both regulatory and non-regulatory agencies base decisions from a WRR, integration and the use of the watershed approach will become implicit and "stovepipe" processes in decision making will become obsolete. The results will streamline the regulatory and non-regulatory processes and ensure maximum environmental results.

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Innovative Methods for Incorporating Tribal Natural Resource Information into the Missouri River Ecosystem Restoration Plan

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The Missouri River Ecosystem Restoration Plan (MRERP) was authorized by Section 5018(a) of the Water Resources Development Act of 2007 to study the Missouri River and its tributaries and determine actions required to mitigate losses of aquatic and terrestrial habitat, recover federally listed species, and restore the ecosystem to prevent further declines among other native species. The MRERP should identify a single, comprehensive and integrated plan to guide the implementation of programs associated with mitigation, recovery, and restoration activities in the basin. There are 29 Native American Tribes or Bands located within the Missouri River Basin or that have a cultural interest in the basin. In keeping with their tribal trust responsibilities, the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service, the lead agencies for development of MRERP, sought to incorporate Tribal Ecological Knowledge into MRERP.

Members of the MRERP Project Delivery Team (PDT) held ten meetings with Native American Tribes across the Missouri River basin to discuss Missouri River natural resources of interest. Representatives of 15 Tribes attended the meetings. A list of seven discussion topics were presented at the meetings, focused on natural resources related to the Missouri River, including species of interest, natural events that sustain or harmed the resources, current conditions of the resources, and observed historical changes to the ecosystem. However, all information provided by the Tribal representatives was gathered for consideration in the planning process. Information from these meetings was categorized into four themes: species of interest to the Tribes; ecological observations/processes; social, cultural, and economic aspects of natural resources; and potential stressors and contributing areas. Based on the Tribal input, a list of 175 species of interest was compiled. These species were compared and supplemented a list of key nested species and ecological systems that had been identified by the technical experts to ensure consideration in MRERP. That comparison resulted in development of a new key nested species assemblage m, Fruit and Berry Species. The ecological observations/processes information were compared with a list of key ecological attributes, critical processes or conditions for sustaining the ecosystem, and indicators, the proposed measures for determining the health of the key ecological attributes. The Tribal information resulted in proposed new indicators that are under evaluation for inclusion in the baseline assessment process. Information gathered on social, cultural, and economic aspects of natural resources, potential stressors, and contributing areas will be incorporated into upcoming planning tasks focused on identifying areas outside of the mainstem Missouri River that are important to the health of the key ecological attributes as well as used in developing the affected environment.

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Responses of Floodplain Wetland Vegetation to Kissimmee River Restoration Project Phase I

Lawrence J. Spencer and *Stephen G. Bousquin*

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The first phase of the Kissimmee River Restoration Project, completed in 2001, backfilled 12 km of the C-38 flood control canal, and reestablished partial inundation of the river's floodplain. The canal, completed in 1971, had channelized the river and floodplain 30 years earlier and effectively eliminated seasonal inundation of the floodplain. Comparisons of vegetation maps based on 2003 and 2008 aerial imagery (two and seven years following completion of Phase I, respectively) to vegetation maps from 1954 (pre-channelization), 1974 (three years after channelization), and 1996 (25 years after channelization) were used to evaluate the broad-scale responses of floodplain vegetation to partial reestablishment of floodplain inundation.

Results from these analyses show that wetland plant communities rebounded quickly, more than doubling in area within two years of completion of Phase I; and that by 2008 wetlands had recovered to near pre-channelization levels. However, the proportions of specific marsh types were different between the pre-channelization and post-Phase I vegetation maps which suggests that suitable hydrologic conditions similar to the pre-channelization system have not yet occurred. Before channelization, the floodplain was dominated by broadleaf marsh communities associated with extended, deep annual flooding, while shorter-hydroperiod wetland communities dominated the floodplain in both 2003 and 2008.

This finding concurs with restoration expectations developed prior to Phase I, which predicted that broadleaf marsh reestablishment would be prolonged because suitable hydrology is dependent on restoration components that will not be in place until completion of additional construction (currently projected for 2014) and associated changes in inflow regulation. Hydrologic data for the Phase I area confirm that the duration and variability of floodplain inundation have not yet been fully restored over the entire Phase I area. Other factors affecting vegetation response are likely involved, including the age and viability of the seedbank, the rarity of relict propagule sources following the channelized period, and competition from an invasive wetland shrub species.

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Benefits of Monitoring Common Loon Restoration Following the *North Cape Oil Spill*

Molly B. Sperduto¹ and *David C. Evers*²

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Following the *North Cape* Oil Spill off the coast of Rhode Island in 1996, hundreds of Common Loons (*Gavia immer*) were killed. State and federal natural resource trustees estimated total mortality and utilized economic scaling tools (resource equivalency analysis) to calculate restoration needed to offset the injury. A settlement was negotiated with the Responsible Party and a restoration program was implemented to protect Common Loon nesting habitat and prevent future declines in productivity. This effort was monitored for 5 years to assess the restoration program's success. Results from the monitoring show that restoration goals were achieved, in part due to the efforts of numerous land trusts, states and other organizations. Monitoring is a critical part of the Natural Resource Damage Assessment and Restoration Program because it: 1) evaluates program effectiveness; 2) provides an opportunity to ground-check ongoing efforts; 3) demonstrates commitment to projects; 4) educates communities about restoration; and 5) informs and improves future restoration efforts.

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Indiana Toll Road Mitigation, Urban Restoration in Gary, Indiana

*Greg Quartucci*¹, *Pau Fornes*² and *Robert Ladson*³ – presented by **Anthony St. Aubin**¹

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To accommodate increases in traffic capacity and improve vehicle transportation on I-90 in Gary, Indiana, the Indiana Toll Road Concession Company retained the Indiana Toll Road Contractors (ITRC) to improve the Indiana Toll Road from MP 10.6 to MP 14.0, including roadway widening. The project area lies in a part of Gary, Indiana, that is relatively rich in natural resources, including several nature preserves, wet prairies, and dune and swale wetland complexes. While most wetland impacts were avoided, impacts to just over one acre of low-quality wetlands in roadside swales and ditches did occur, as well as discharge of 10 cubic yards of rip-rap within the Grand Calumet River.

JFNew and Associates with the ITRC and Indiana Toll Road Concessionaire Company (ITRCC) developed a mitigation plan consistent with the Chicago Wilderness's strategic initiatives focusing on public outreach, transportation planning and biodiversity, and urban sustainability and management focusing on locally based mitigation. Rather than replace the impacted roadside swales and ditches, the restoration team of ITRC, ITRCC, and JFNew developed a strategy to maximize wetland mitigation value by conserving and adding to urban biodiversity. Through collaboration with federal and state agencies and local environmental groups, the team developed an urban-focused mitigation plan, including restoration of one acre of globally threatened dune and swale habitat in Gary's urban core, restoration and preservation of a high quality prairie, and purchase of 1.5 acres of wet prairie from the Lake Station Wetland Bank. The proposed dune and swale restoration site is adjacent to the Ivanhoe Nature Preserve, located directly south of the project area. The Nature Conservancy currently manages the nature preserve and is involved in the reestablishment of the Karner blue butterfly, a federally protected species, at this site.

These projects will be completed by the Summer of 2011. The presentation will focus on how this mitigation approach was developed and the lessons learned and challenges faced in the first year. Natural restoration and maintenance techniques will also be addressed.

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Restoration Conversion of Boreal Forest Wetlands in Superior, Wisconsin

Nicole K. Staskowski – presented by **Anthony St. Aubin**

JFNew and Associates, Inc., Verona, Wisconsin, USA

In 2010, JFNew completed the third year of a 120-acre restoration project in compensation for forested wetland conversion impacts along a new transmission line in northwestern Wisconsin. JFNew designed a restoration plan for the site located within the Superior Coastal Plain in northwestern Wisconsin. The site includes a headwater tributary of the Pokegama River, which flows into Lake Superior. The Wisconsin DNR was consulted initially and throughout the project to ensure the plan aligned with the goals of the State Wildlife Action Plan. The restoration project activities are three-fold: removal of aggressive woody species, planting of boreal forest tree species and monitoring to assess the success of conversion. The first two activities, the removal of aggressive woody species and planting of appropriate boreal forest species, are taking place over the first four years of the restoration. Woody vegetation that is targeted for control as part of this phase includes *Populus tremuloides*, *Alnus incana* and various *Salix* species. Woody removal activities include cut stump treatment, forestry mowing and targeted, aquatic-approved herbicide treatment. Native boreal forest species are targeted for planting across the site. In the wetland areas these include *Picea mariana*, *Larix laricina* and *Thuja occidentalis*; in the upland islands these include *Picea glauca*, *Pinus strobus*, *Abies balsamea* and *Thuja occidentalis*. Restoration work and monitoring began in 2008. The goal of the project is to set the successional trajectory of the site to support an assemblage of boreal forest (conifer) tree species within 10 years. This is largely measured by survival of trees and reduction of invasive species across the site. In addition to the boreal forest conversion monitoring, state listed plant monitoring is also required within the wetland areas. Populations of the State Threatened *Petasites sagittatus* and *Salix planifolia* were identified and are being protected on the site.

Restoration and monitoring activities began in 2008 and preliminary results indicate a greater than 80% tree survival rate in the northern wet forest conversion areas, greater than 60% survival in the boreal forest areas, less than 5% invasive species cover across the entire site, and a positive increase in boreal forest conifer species.

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Skokie River Woods Wetland Restoration and Enhancement Project

Anthony J. St. Aubin

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An approximately 25-acre site owned by the City of Highland Park, Illinois, was in need of wetland restoration and wetland and stream enhancement. Invasive shrubs, trees, and herbaceous vegetation had become established and were impacting the ecological value of the site. Prior to site excavation, this vegetation was removed. Wetland restoration occurred in two areas of the site. Along the eastern property line, it was accomplished through excavation of existing fills to expose historic hydric soils found and mapped on the site. Excavated areas were revegetated with a wet meadow seed mix, and the side slopes were planted in mesic prairie. Near the south end of Skokie River Woods, wetlands restoration consisted of removing a decrepit dam and constructing a new adjustable water level structure at the southernmost limits of hydric soils. In addition, the Skokie River Woods project included wetland buffer and upland restoration, to add further to the site's overall ecological value. The project restored and created 1.50 acres of wetlands, enhanced 13.75 acres of wetland, and enhanced 5.0 acres of oak-hickory woodland buffer. Following construction, management activities such as selective herbicide application, mowing, and replanting, were conducted for five years to help maintain the site and meet project objectives. The site was also subject to a five year monitoring plan which included monitoring for vegetative quality, using transect surveys, and for hydrological response to restoration activities using data loggers. Following final design, the project involved obtaining permits from the U.S. Army Corps of Engineers and the Lake County Stormwater Management Commission.

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Organizing New Science to Adaptively Manage a Restoration Vision: Lessons Learned from the Everglades

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The Comprehensive Everglades Restoration Plan (CERP), authorized in 1999, outlined a set of broad goals and objectives for Everglades and south Florida ecosystem restoration. Inherent in the Plan was the recognition of uncertainties about the specific characteristics of the restored ecosystem and desired endpoints, and the understanding that more precise targets would be developed over time as restoration proceeded and new information became available. After ten years of ongoing monitoring and research, an effort to employ this information to better define the attributes of a restored ecosystem is being initiated by RECOVER, the multi-agency scientific arm of CERP, as part of the CERP adaptive management program and is known as the Shared Definition of Everglades Restoration. The first phase of the effort is the compilation of relevant scientific information from monitoring and research on ecology, engineering advances, and modeling tools into a Scientific Knowledge Gained document.

This presentation will outline the process used by RECOVER to develop this document, and offer insight into the applicability of this process and the overall effort to other ecosystem restoration programs. Topics covered by this presentation will include an overview of the rationale for initiating the effort; the criteria used for selecting topics and authors; the role of stakeholder input through public workshops and review periods; and the overarching challenges of developing a comprehensive scientific summary under a multi-agency team and maintaining objectivity. This presentation will also discuss how this document will be used in the next two phases of the Shared Definition effort, aimed at fine-tuning CERP goals and targets and specifying measurable, shorter-term goals and targets to guide future planning, implementation and operations. The process used to develop the Scientific Knowledge Gained document and the overall effort is applicable to other ecosystem restoration programs facing uncertainties about restoration endpoints and challenges with communicating new scientific information to decision makers as part of adaptive management.

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Urban Ecosystem Restoration: An Example of Stream and Lake Restoration in Metropolitan Atlanta, Georgia

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Gwinnett County, Georgia is part of the urban metropolitan Atlanta region. In order to mitigate the adverse effects that growth has on its aquatic resources, the county has developed a comprehensive Watershed Improvement Program (WIP). The focus of the WIP is to address areas negatively affected by increased stormwater flows and ongoing land use practices from urban development. The Lake Claiborne project is located within the County's Sweetwater Watershed and is part of the Sweetwater Creek WIP Implementation. The goals of the restoration project were to improve water quality, habitat, biology, and the overall condition and health of Sweetwater Creek, its tributary and Lake Claiborne. The project included improvements designed to restore the original storage capacity of the lake and stream restoration of Sweetwater Creek and the tributary to improve aquatic habitat.

Prior to construction, the lake had a surface area of approximately 5 acres and is located on a 12 acre county-owned property adjacent to single family homes. The lake drainage area is 554 acres, with an impervious cover of 25 percent. The lake was constructed in the 1960s with a significantly larger open water footprint. The lake filled in with sediment over the years from increased development within the watershed. As a result, the stream segments were aggraded and the depth of the lake decreased with large areas of the lake less than one to two feet deep. Relatively dense vegetation covered accumulated sediment along the tributaries adjacent to the lake. Pre-construction water quality sampling and biological monitoring determined macroinvertebrate habitats were poor. Post-construction monitoring will be performed to measure improvements.

The lake restoration improvements included removing accumulated sediment to restore the original design capacity and increase flood storage capacity without increasing the current effective 100-year floodplain elevation. The lake outlet control structure was modified to provide detention and peak flow attenuation for 2- through the 100-year storms. Stream restoration included redesigning the two streams flowing to the lake by restoring the channel geometry and profiles to improve transport of sediment load. Offline ponds for sediment accumulation were built in the northeast and northwest corners of the project within the original 100-year floodplain boundary of the lake. Boulder cross vanes with adjustable weirs were constructed in the inlet channels at the entrance of these offline ponds and split base flow equally into the streams and the offline ponds. Grading was done around the lake and ponds to establish a functional littoral zone to provide additional filtering and habitat. Finally, enhancement of the riparian buffer was accomplished by removing invasive vegetation (predominantly Chinese privet) and replanting with native species including trees, shrubs, and herbs appropriate for the various planting zones.

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Selected Molluscan Species as Tools for Restoration of the Greater Everglades Ecosystem, Florida

Bethany Stackhouse and *Tara Colley*

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A critical component of the Greater Everglades Ecosystem Restoration is to identify targets and performance measures based on pre-1900 alteration patterns. Paleoecologic analyses provide this information, but in order to understand patterns seen in sediment cores, we need to understand the modern environment and the ecology of the living organisms. This study focuses on species that are good indicators of specific environmental conditions such as salinity, temperature, and/or habitat.

Samples of modern indicator species were collected from Florida Bay, Biscayne Bay, and the southwest coastal region from 2008-2011 for count data. Sampling methods included petite ponar grabs, grid samples, and counts of live specimens with no physical sample collection. Salinity measurements were taken at each collection site unless taken in a terrestrial location. Based on live specimens counted in a fixed sample size, population densities were estimated as number of living individuals per meter squared for the indicator species. *Melampus coffeus* and *Truncatella* spp. are both air breathing gastropods that are good indicators of specific habitats. *Melampus coffeus* is found living on mudflats and during periods of high tide, on mangrove roots above the water surface. The mean density of *Melampus coffeus* was calculated to be 48 live individuals per m² with a range of 8/m² for the minimum and 400/m² for the maximum. *Truncatella pulchella* and *T. caribaeensis* are found living together in the swash zone about 2-3 meters above the regular high tide mark under decaying sub-aquatic vegetation mats. They occur most abundantly in a very distinct layer where damp vegetation, mostly *Thalassia*, is decomposing into soil, but just above the carbonate sand layer. The mean density was estimated to be 8,936/m², with 48/m² being the minimum and 17,280/m², the maximum. *Batillaria minima* is a gastropod usually found in the subtidal to intertidal zone, however, the substrate varies from fine mud and calcareous sand to rock rubble and coarse shell hash. This species is extremely tolerant of a wide salinity range, thriving in environments spanning 1.56 ppt to 40.10 ppt. Density estimates vary from 32/m² to 24,347/m² with 4,001/m² being the average. Hydrobiids, a group of mostly freshwater gastropods, were found living at salinity levels up to 36.20 ppt in channel waters. Wingard et al. (2006) suggested that minute Hydrobiids may raft on freshwater currents into more saline waters. Additional density estimates and salinity averages have been calculated for other indicator species and all field data can be found at <http://sofia.usgs.gov/exchange/flaecohist/>.

By observing modern habitats, salinities, and densities of specific indicator species, their presence in cores from the Everglades estuaries aids in the reconstruction of the paleoenvironment. Core analyses provide an interpretation of the Everglades ecosystem before anthropogenic influences, serving as a model for restoration efforts. Return of water flow and salinity levels to a more natural cycle is critical in the preservation of this unique ecosystem.

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The Nature Conservancy's Ecosystem Restoration Strategies and Objectives for the Ohio River Basin

John Stark

The Nature Conservancy, Dublin, OH, USA

The Nature Conservancy designated the upper Ohio River as an integrated landscape scale project in 2008. The geographic scope of this large interstate effort ultimately was defined as the Ohio River Basin minus the watersheds of the Tennessee and Cumberland Rivers (143,550 sq mi). Internal conservation objectives were developed that focused on the restoration of the Great River Fishes (e.g. sturgeon sp., paddlefish, alligator gar, and inland herring sp.) and freshwater mussels. Driven by the realization that appropriate conservation at scale would necessarily involve restoration at scale, The Nature Conservancy also engaged in collaborative planning with other broad coalitions to develop sustainable aquatic restoration strategies. Results of internal and collaborative planning are presented during this session.

[This is one component of the 4 presentations for the proposed Ohio River Basin session.]

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An Introduction to the Baltimore Watershed Agreement Action Plan

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The Baltimore Watershed Agreement (BWA) was executed in 2002 to formalize the joint commitments and vision of Baltimore City and Baltimore County to address pollution problems in the region's watersheds. Baltimore City and Baltimore County agreed to improve cooperative inter-agency management of environmental resources. In December 2006, leaders from Baltimore City and Baltimore County signed the second regional watershed agreement, emphasizing the value and importance of cooperation in addressing water quality and regional watershed issues while highlighting progress. The Baltimore Watershed Agreement Action Plan (BWAAP), an in-depth stakeholder effort, approved in 2009, set goals and actions for a first Phase from 2009 through 2012. The BWAAP Actions are organized within five over-arching categories (Development and Redevelopment, Community Greening, Stormwater, Public Health and Trash) and five specific topic areas (Implementation, Policy & Regulation, Planning & Collaboration, Education and Outreach & Awareness).

From 2009 through today, representatives from Baltimore County, Baltimore City, and NGO stakeholders have worked to implement the BWAAP actions. Biohabitats, a consultant to Baltimore County and City has helped to facilitate and coordinate BWAAP efforts. Some of the actions are motivated by regulatory requirements such as NPDES MS4 permits and TMDLs. Others address joint initiatives on overarching themes such as sustainable communities and environmental justice.

County staff, City staff, and NGO stakeholders have experienced both challenges and successes in implementing the Plan. A BWA workgroup composed of County and City staff have met quarterly to discuss, track, and further Action Plan. The additional speakers representing Baltimore County, Baltimore City, and the Baltimore Watershed Alliance NGO within this session will share some of these challenges and successes in collaborative monitoring, watershed planning, and public outreach and awareness efforts.

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The Baltimore Watershed Agreement Cooperative Monitoring Efforts

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A key component of the Baltimore Watershed Agreement is to develop comparability in monitoring methods and analysis across jurisdictional boundaries. The County and City have made joint efforts to align water quality monitoring practices for chemical, biological, bacteria, and trash sampling. Ultimately, the resulting information will inform more comprehensive and cooperative watershed planning.

The initial focus was on comparability in chemical water quality sampling methods; both in the field and the laboratory. While County and City field methods for chemical water quality sampling are not the same, they provide comparable water samples. The laboratory comparability is more challenging. Baltimore City uses five separate laboratories for water quality chemical analysis, while Baltimore County uses only one. County and City staff are still working on this aspect.

The County and City have also established common methods for biological, bacteria, and trash monitoring. The stream community biological sampling is directly comparable since both the City and County use the established Maryland Biological Stream Survey methods. Recently, the City and County have established a bacteria monitoring program in response to the development of bacteria Total Maximum Daily Loads (TMDLs) for our shared waterways. A joint trash monitoring program has been established to develop data for the development of a trash TMDL. While the sampling methods are different, the analysis methodology will yield comparable results.

One of the main drivers for establishing monitoring comparability is the development of a biennial State of Our Watersheds Report to be distributed to stakeholders at a biennial conference on water quality. County and City staff struggled with the comparability issue when developing the first report in 2003. Although some comparability issues remain to be resolved, compiling the data and creating the report have become much less onerous. The resulting benefits of establishing communication between the monitoring counterparts in the two jurisdictions include shared experience that benefits efficiency, resolution of problems as they arise, and a greater sense of the overall watershed and watershed issues.

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Calculating Net Benefits of Ecosystem Restoration in Coastal Texas

David L. Stites, Michael Krecic and William Hunt

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Estimates of ecosystem restoration and enhancement benefits are becoming increasingly important in justifying restoration costs to skeptical legislators and the public. Demonstrating that ecosystem restoration has a net positive economic value by comparing the dollar values of ecosystem services to the project development costs provides one means of demonstrating the value of the (most often public) expenditures. This study classified and estimated economic and financial benefits associated with commercial and recreational fishing, tourism and ecotourism (wildlife viewing), property values, out-of-state visitor spending, and storm protection for several estuarine restoration and enhancement projects along the Texas Gulf of Mexico coastline.

Ecosystem services costs were developed by obtaining relevant local and regional ecosystem services dollar estimates from available literature, and estimating the "actual" value of each service for each project based on the likely level of specific services that each restoration might provide. The stream of economic benefits over time varied from project to project depending on the durability of the project and the set of benefits provided by each project. The period of analysis for the various projects varies from 10 to 20 years, with the longer periods applicable to projects with hard structures (e.g., revetments and breakwaters) or located in areas that are likely to remain intact over at least that period.

The cost: benefit ratio (the total estimated benefits of a project divided by the cost of the constructed project) provided a measure of net economic benefits for each project. In some cases, a net positive benefit (cost: benefit ratio greater than one) did not accrue until after 10 years.

Because the analyses were developed for the Texas General Land Office, this study adopts a Texas accounting perspective or stance. Funding from outside Texas and spending by visitors from outside the state represent financial benefits to the state. A Texas accounting stance views project contributions normally considered a cost when viewed from a national or world perspective as a financial benefit. Costs funded by non-Texas dollars represent a financial benefit because money flows into the Texas economy. This adjustment has occurred where appropriate to reflect the Texas accounting perspective for the estimates of benefits and costs. This report serves to estimate the cost effectiveness of the five projects via benefit to cost ratios.

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Developing a “Toolkit” for Climate Change Adaptation in Virginia’s Tidal Shoreline Communities

William A. Stiles, Jr.

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Wetlands Watch, a nonprofit, grassroots advocacy organization, has been working at the local government level for nearly four years to help establish adaptation strategies along Virginia’s tidal shoreline. Initially the focus of the work was to protect the tidal shoreline ecosystem from the impacts of climate change, in response to an estimate made by Wetlands Watch in 2007 that with the then-expected centennial rate of sea level rise of 2 feet, Virginia stood to lose between 50 and 80 percent of its tidal wetlands.

The higher loss range assumed that shoreline development and hardening would take place, effectively blocking the ability of the shoreline ecosystem to “migrate uphill” with rising sea levels. Shoreline development conditions are thus a major factor in future coastal ecosystem health and resiliency (Titus, 2010). With the vast majority of the tidal shoreline in Virginia privately owned and given that local governments control most private property development and erosion control decisions, local governments are central to sea level rise adaptation strategy development.

Wetlands Watch’s focus on the impacts of climate change on natural resources was minimally effective at moving adaptation strategies into local government planning efforts and has produced no changes in land use or shoreline development decisions. A focus on the future impacts of climate change on the shoreline environment was too distant and abstract a concept to change local government decisions. Local governments and individual landowners are unwilling to stop shoreline development and forgo property tax revenue and economic gain in the present to avoid an uncertain cost in the distant future. In response, a new approach was developed that focuses on present impacts of sea level rise (increased shoreline inundation from storm surges), economic consequences (higher insurance rates and business losses), and broader impacts beyond the coastal ecosystem (threats to property, infrastructure, and public safety). Wetlands Watch reasoned that using this framework and approach would move a tidal shoreline community to begin adaptation sooner and ecosystem protections could be included in any resulting actions.

With this broader focus, Wetlands Watch reviewed myriad authorities and programs at the local and regional government levels and has developed a “toolkit” of approaches that local governments and regional authorities can use to begin adaptation planning today. Wetlands Watch is developing a pilot program to test these adaptation approaches in southeastern Virginia, whose economy is heavily water dependent (shipbuilding and ship repair, shipping and port activity, oceanfront tourism, and strong US Navy presence).

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Coordinating a Multi-Year, Multi-Million Dollar Watershed-Wide Fish Passage Program – A Case Study of Major Dam Natural Fishways and Removal - Coordination of Partners, Public Input, Funding, and Other Resources for Measurable Outcomes

Andrew Struck

Ozaukee County, Port Washington, WI, USA

In June 2009, Ozaukee County (WI) was awarded \$5.2 million in federal funding from the National Oceanic and Atmospheric Administration (NOAA) – Great Lakes Program for an 18-month "Milwaukee River Watershed Fish Passage Program". The Program was at once a culmination of previously completed work, an extension of existing partnerships, the genesis of a novel large-scale natural resources connectivity and reclamation initiative, and the impetus for developing and nurturing new partnerships within and beyond Ozaukee County.

The keystone project of the comprehensive, watershed-scale Fish Passage Program is the modification or removal of three major dams along the mainstem of the Milwaukee River that resulted in a high level of coordination amongst a multitude of partners on research, design and engineering, public input and cooperative funding.

Tackling the watershed-scale program, however, required existing partnerships to be bolstered and new ones in both private and public sectors to be initiated. Unique challenges, public input, unanticipated funding considerations, and many other obstacles to Program success were navigated. This session will detail the genesis, coordination, public input, design and engineering, and management of the Program through a case study of the modification or removal of these three major dams. The session will explore the challenges of a watershed-scale program and providing measurable outcomes through the keystone dam project case study.

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The Baltimore Watershed Agreement: Challenges & Successes of Collaborative County, City, & NGO Watershed Planning

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Improving watershed-planning efforts through collaboration across jurisdictions and among agencies is a major goal within the Baltimore Watershed Agreement BWA. A key component of this goal is to better integrate watershed plans into planning and zoning processes, review and permitting, enforcement and implementation. BWA planning actions include: redevelopment benefits and challenges of meeting stormwater regulations, integrating and standardizing GIS data between the City and County, green building policies, Transit Oriented Development (TOD) and its ability to improve air and water quality, and watershed restoration plans.

As a step towards collaborative watershed planning, the County and City now staff a new Planning Workgroup (as of October 21, 2009). The Workgroup implements the Agreement Action Plan and includes representatives from both jurisdictions and staff from multiple County and City Departments. Additional representatives from Maryland Department of the Environment, State Highway Administration, and US Fish and Wildlife Service have been invited.

Baltimore County and Baltimore City continue to work on watershed restoration plans, including the new Direct Harbor Watershed Plan. Both jurisdictions are also working more closely on implementing BMP's and stream restorations in existing watershed plans and to identify gaps to inform implementation.

Some of the BWA challenges include GIS mapping efforts and funding for implementation and staffing for BWA Actions. While GIS mapping is a principal planning tool under the Agreement to set policy on protecting water quality, address environmental justice, and identify synergies, GIS coordination continues to be an ambitious and challenging effort and requires major coordination between County and City. Funding for BWA actions which are not already encompassed in existing County and City programs has been an ongoing challenge.

By collaborating on the BWA, the County, City, NGOs, and stakeholders hope to share in planning-related successes and challenges towards healthier shared watersheds.

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Resilience of Coastal Louisiana

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The devastation caused in Louisiana by Hurricanes Katrina and Rita in 2005 magnified the urgency of addressing Louisiana's ongoing land loss crisis and of gaining a better understanding of the risks and vulnerabilities associated with living and working in coastal Louisiana. With the passage of Louisiana Legislative Act 8 in November of 2005, the Legislature created the Coastal Protection and Restoration Authority (CPRA) and charged this body with developing policies to integrate flood protection with wetlands restoration. Additionally, the CPRA was charged with coordinating efforts between the State and its local and federal partners to achieve comprehensive, sustainable coastal protection and restoration. In keeping with the mandates of Act 8, the Legislature adopted Louisiana's first "Comprehensive Master Plan for a Sustainable Coast" (Master Plan) in 2007, which stresses the need to achieve sustainable coastal ecosystems and flood protection initiatives so that human and natural communities will thrive over the long term.

The 2007 Master Plan also acknowledged the need for Louisiana's coastal communities to adapt to and recover from changes- i.e., to become more resilient to vulnerabilities. To become more resilient, policies must be developed so that communities will survive and prosper under changing conditions. Creative thinking beyond the norm that incorporates best practices from other disciplines such as architecture, land development, engineering, and construction is needed. Redesigning and redeveloping communities while retaining inherent characteristics are critical to achieving resiliency in communities. Resiliency also takes into account long-term changes to the coastline, whether due to subsidence, oil spills, hurricanes, or climate change. Lessons learned from communities who have confronted and conquered such challenges while retaining their identity will assist with the developing of a resilient coastal Louisiana.

This presentation will examine Louisiana's ongoing efforts to develop resilient coastal communities, the supporting role of the NGOs, the various tools available to assess our progress, and how the concept of resiliency differs in various communities along our coast. Shared community visions, sound fiscal and economic development policies, land development strategies, and the effective balance of differing interests are some of the elements that will be discussed in this presentation.

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Strategic Stakeholder Engagement Crucial to Building Broad-based Support for Large Scale Coastal Protection and Restoration Efforts in Louisiana

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Since the 1930's, Louisiana has lost over 2,400 square miles of coastal lands, and continues to do so at a rate of approximately 23 square miles per year. The critical need to address this land loss crisis was magnified by the devastation of Hurricanes Katrina and Rita in 2005. Act 8 of the 2005 Louisiana Legislature created the Coastal Protection and Restoration Authority and charged this body with coordinating the efforts of the State and its federal and local partners in order to achieve comprehensive, sustainable coastal protection and restoration. Following public hearings, the State's first Master Plan was adopted by the Legislature in the spring of 2007. In keeping with the mandates of the Act, the State is developing the plan's first five-year update and revision.

Recognizing the complex nature of coastal change, the Office of Coastal Protection and Restoration (OCPR), has convened a Master Plan Delivery Team (MPDT) and a Framework Development Team which include representation from a diverse group of scientific, technical and environmental expertise and community leaders. Together, these teams have developed a Strategic Framework for Outreach and Engagement (OE). This framework provides an overall game plan for the OCPR to identify and engage key decision makers and stakeholders early on in the planning process with the goal of developing broad-based support and approval for the 2012 Master Plan Update. The OE framework also offers specific strategies on how to engage each group, methods for communicating critical elements of the plan and proposes timelines for OE activities. Key to this effort is the use of Regional Stakeholder Workgroups: public meetings in specific geographic planning areas to solicit input from those individuals and groups likely to experience the most impacts of coastal change.

OCPR's early engagement of stakeholders and its substantial commitment to engagement and outreach will provide an opportunity to develop a broad base of community support, increase the likelihood of Legislative approval and create the political will necessary for plan implementation.

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Enhancing Coastal Resilience with Integrated Planning by the State of Maryland

Bhaskaran Subramanian and *Kevin Smith*

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Maryland's shorelines are facing increasing impacts from erosion, sea-level rise, climate change and other perturbations to nearshore habitats. These environmental disturbances are responsible for significant erosion in the Bay system. The State of Maryland has been actively pursuing programs to tackle some of the issues challenging the Bay. One such measure is the Living Shorelines Protection Act of 2008. This Law involves adopting an ecosystem-based approach to shoreline disturbances.

Living shoreline (LS) projects provide a system that help to absorb and buffer wave energy, storm surges and sea-level rise. LS projects respond and recover in a unique way as opposed to conventional riprap or bulkhead. These LS projects not only minimize the coastal erosion, but also help in maintaining the coastal processes and provide resilience for future sea-level rise, while enhancing valuable habitats. Maryland Department of Natural Resources (DNR) is increasingly involved in shoreline projects that integrate the upland treatment with the shoreline in order to find wholesome solution to shoreline issues. A recent project in Queen Anne's County on the Corsica River is an excellent case in point.

DNR also strongly feels that by "actively deciding not to pursue" projects on certain shorelines (e.g., high bluff), the State is enabling resiliency to disturbances. The beaches and marshes that are in the downstream of these eroding shorelines largely depend on these sediments to maintain their unique habitats. By proactively deciding not to "fix" these shorelines and viewing them from a resource standpoint, the State can benefit from such system-based approaches.

With the development of models such as SLAMM (Sea Levels Affecting Marshes Model) and SLR (Sea Level Rise), sea-level rise and climate change are beginning to be incorporated in designing shoreline projects. A good case in point is the City of Annapolis where DNR is assisting in the development of a comprehensive shoreline management plan which will incorporate sea-level predictions and resiliency.

With an ever-increasing level of stressors to the State's tidal/coastal shoreline, it is becoming increasingly clear that integrated planning between agencies and the incorporation of sea-level rise predictors will play a major role in preparing for the future.

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Concept and Approaches for Adding Environmental Enhancements to Great Lakes Breakwaters and Jetties

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The overall goal of this effort is to increase application of environmental sustainability to the design and maintenance activities associated with Great Lakes breakwaters, jetties, and other navigation infrastructure. At present, when new structures are built or existing ones are maintained, the primary objectives are to meet the navigation safety objectives and minimize, to the extent feasible, adverse environmental impacts. Our study goal is to add an additional objective to such efforts to also look for opportunities to design or maintain the structures such that they provide better ecosystem habitat or achieve some level of greater sustainability. This would involve managers, planners, engineers, and ecologists taking some time to ask “Could we be creative and do more for ecosystem services in addition to serving the primary project purpose?” Such creative efforts might involve adding design features to the structures that would enhance fish spawning habitat, create preferable species habitat or refuge, or serve other ecosystem needs. For example, adding short spurs to a jetty may increase habitat diversity and substantially increase use by certain species life stages, or adding a gravel apron in front of a rock breakwater might both absorb wave energy and provide fish spawning habitat.

The study approach involved (1) assembling an inventory of potential actions that could be conducted to add environmental enhancements to Great Lakes navigation infrastructure through interaction with regional experts, (2) classifying the existing navigation infrastructure, (3) developing a compatibility matrix of the potential actions and infrastructure classes, (4) developing a project geo-database, (5) conducting a screening demonstration, and (6) recommending possible pilot projects, especially in association with Great Lakes Areas of Concern (AOC).

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Environmental Restoration as a Decision-Analytical Problem: Approach and USACE Experience

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Ecosystem restoration involves human interventions oriented toward enhancing the structure, function and dynamic process of degraded ecosystems. However, due to the multiplicity of possible restoration interventions and their uncertain outcomes, environmental planners have difficulty deciding which restoration interventions are best for their specific contexts. Structured decision making tools can help environmental planners select alternatives (e.g., restoration plans) that maximize the utility of a given decision with explicit consideration of the associated uncertainty and limited resource availability. We will show the approach developed for integrating structured decision making tools into restoration projects, with the focus being on maximizing the environmental benefits of the restoration investment. The approach will provide specificity to ecosystem restoration projects, and the granularity necessary to integrate environmental and ecological data. We will show how structured-decision-making tools and techniques can be integrated into the 6-step Corps planning process and explore how they might be applied to ecosystem restoration projects.

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A Progress Report for Mississippi River Basin Healthy Watersheds Initiative Implementation in Arkansas

Mike Sullivan and *Nancy Young*

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NRCS is returning to some of the basic founding principles utilized by Hugh Hammond Bennett with the Mississippi River Basin Healthy Watersheds Initiative (MRBI). Technical specialists from the agency and partners are working with producers to help develop and implement farm-scale conservation plans within selected watersheds of the Mississippi Basin. Objectives of MRBI are to accelerate assistance in approved project areas to help producers avoid, control, and trap nutrients; improve wildlife habitat, and maintain agricultural productivity.

Conservation efforts to date in Arkansas will be examined. The MRBI watershed selection process in Arkansas will be discussed and projects approved for funding in FY10 and FY11 will be presented including progress and challenges to date. Monitoring and assessment strategy for AR MRBI will be presented and outcomes expected in AR will be outlined including integration of water quality/quantity benefits in the Lower MS Delta, ecosystem restoration benefits, limitations of existing MRBI efforts, and potential beyond MRBI.

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Yellowstone River - Intake Dam Fish Passage and Entrainment Prevention

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As part of an effort to recover the endangered Pallid Sturgeon in the Missouri River basin, modifications have been proposed to an irrigation diversion structure and weir on the Yellowstone River. The structure is composed of a low-head diversion weir which prevents passage of most fish species upstream of the structure. Also, the gates of the diversion structure allow many fish to be trapped within the diversion canal itself once upstream. The proposed solution consists of a newly constructed diversion headworks with cylindrical fish screens to prevent entrainment and a rock ramp spanning the full width of the river to facilitate passage.

Design of project features includes the use of both numerical and physical modeling. For fish passage, the approach to and preliminary results from numerical modeling used to evaluate key parameters relative to success criteria are presented. Ongoing analyses to overcome challenges encountered with entrainment prevention are discussed."

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Estimation and Prediction of Coastal Landscape Changes Utilizing a Hydrodynamic Simulator and Aerial Photogrammetry

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Determining historic landscape changes in conjunction with hydrologic conditions is a primary goal of ecosystem restoration research in order to estimate future changes to the hydrology and landscape. Numerical models representing a fully hydrodynamic surface-water system coupled to a three-dimensional groundwater system have been developed for hydrologic analysis and prediction of flows, stages, and salinities in South Florida. The numerical code used for these computations is the Flow and Transport in a Linked Overland/Aquifer Density-Dependent System (FTLOADDS). The Biscayne Southern Everglades Coastal Transport (BISECT) model uses FTLOADDS to simulate existing, historic, and future predicted hydrologic conditions in the Everglades National Park and lower East Coast urban area. Model-predicted inundation periods and depths can be produced for the different hydrologic scenarios, which then can be related to different vegetation types. The detailed hydrodynamic computations within the FTLOADDS numerical code allow for simulation of short-timescale hydrologic variations, such as storms, to be accounted for in the analysis. These simulated results along with historic photogrammetry can be used to stochastically determine differences in topography and flow patterns between early 20th century and current conditions. This information can then be extrapolated to the prediction of future landscape changes and their potential implications to the ecosystem

Several simulations were implemented for historic periods in the 1920's and 1930's, taking into account historical tidal levels, flows, and storms. Simulated inundation periods are stochastically correlated with landscape information derived from the historic photogrammetry. The simulation uses automatic parameter-estimation techniques to generate topographic values to fit the historically derived inundations and levels. Comparisons between simulated historic and existing conditions indicate that historically lower groundwater levels and topographic sloughs combined with historically lower tidal levels produce less inundation and lower coastal surface-water salinities. Storm events are shown to induce salinity intrusion that can effect vegetation populations for years afterwards.

The results of the analysis provide information for a number of other ecologic modeling efforts. The MANHAM model of mangrove/hammock populations utilizes salinity information to predict long-term coastal vegetation changes. These predictions can take into account elevation changes projected from the BISECT research. Other ecologic models representing population dynamics of crocodiles, fishes, and wading birds can use predicted hydrologic conditions from the BISECT model to simulated future ecological conditions.

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Evaluating the Potential Impacts of Sea-Level Rise and the Comprehensive Everglades Restoration Plan (CERP) on South Florida Using the Biscayne and Southern Everglades Coastal Transport (BISECT) Model

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Low elevation and flat-lying topography in Miami-Dade and Monroe Counties make the area especially prone to adverse effects of long-term sea-level rise. An extensive system of canals and coastal flow structures in the area is used to control flooding and saltwater intrusion. If sea level continues to rise, modifications to these canal systems and structures may be necessary to continue providing flood and saltwater intrusion protection in coastal communities. Furthermore, implementation of the Comprehensive Everglades Restoration Plan (CERP) may also affect canal system operation and effectiveness. A numerical model was developed and used to simulate a variety of predictive scenarios to evaluate the combined effects of sea-level rise and CERP implementations.

A fully hydrodynamic, integrated surface-water and groundwater model of southern Florida, the Biscayne and Southern Everglades Coastal Transport (BISECT) model, was used to examine the effects of sea-level rise along with water-management changes on: (1) saltwater intrusion and canal salinities, especially in the well fields and coastal canals of the highly urbanized Lower East Coast area (Miami-Dade County); and (2) surface water salinities and hydro-periods within the Everglades and other natural areas of the southern Florida peninsula. The model domain encompasses all of Miami-Dade County and the majority of Monroe County, excluding the southern Keys, while incorporating all of Everglades and Biscayne National Parks. The model has a 500 x 500 m grid resolution and was calibrated to transient hydrologic conditions for 1996-2004. The calibrated model is used to simulate and predict conditions for the year 2050 using various scenario input data that represents three test cases: (1) sea-level rise only, with estimates ranging between 1 -5 ft, (2) sea-level rise with CERP implementations, i.e. CERPA, or (3) sea-level rise with potential canal system modifications, such as increasing the canal base water levels.

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Criteria, Monitoring and Assessment: Support for Chesapeake Bay TMDL Pollution Diet Development and Tracking Health Progress

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USEPA, in cooperation with its six watershed State partners and the District of Columbia, developed water quality guidance in accordance with section 117b of the Clean Water Act. Chesapeake Bay regional water quality criteria were developed and define conditions protective of Bay living resources and their habitats. Applied assessment procedures incorporate, in their most advanced state, the magnitude, frequency, duration, space and time considerations with biologically based reference curves and cumulative frequency distributions. The Criteria Assessment Protocols Workgroup of the Chesapeake Bay Program has an established forum for resolving details of Baywide criteria assessment procedure development and implementation. New guidance documents are created 1) to provide reference to previously undocumented features of the present procedures, 2) to provide refinements and clarifications to the previously published Chesapeake Bay water quality criteria assessment procedures, and 3) in response to new scientific research and management applications that reveal new insights and knowledge that should be incorporated into revisions of state water quality standards regulations during their triennial reviews.

The Chesapeake Bay water quality criteria have served TMDL development by providing assessment benchmarks for dissolved oxygen, water clarity and chlorophyll *a* measures in Chesapeake Bay tidal waters that supported development of the pollution diet for the watershed. The criteria, their recommended monitoring protocols and assessment procedures, have been adopted into water quality standards used together in the process of tracking and reporting management progress towards those endpoints.

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Retrospective Evaluation of Aquatic Ecosystem Restoration Projects Completed by the US Army Corps of Engineers

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Despite substantial investments in aquatic ecosystem restoration nationally, there is little or no quantitative monitoring of ecological response, and little or no basis upon which to assess project and program success. Furthermore, few national databases have been developed for ecosystem restoration projects. While the US Army Corps of Engineers has made substantial investments in restoration projects over the past 20 years, monitoring and assessment efforts within the Corps largely reflect this pattern. Better data and information is needed to ensure that the Corps' restoration investments maximize environmental benefits to the Nation. This presentation describes an effort to develop and evaluate a database of ecosystem restoration projects completed by the US Army Corps of Engineers. Specific objectives are to evaluate the benefits realized relative to intended objectives, and the performance of selected restoration techniques and practices applied in wetland, coastal/estuary and riverine/stream systems. We also identify lessons learned and noteworthy projects that can help improve the performance and outcomes of future restoration efforts.

A group of academic, interagency, and Corps district experts were convened in 2009 to help formulate and refine the focus and direction of this retrospective analysis, and to assist in identifying a suite of appropriate performance measures and assessment protocols. Methods and detailed guidelines for development of the database have been prepared to ensure a consistent approach to database entry and interpretation across multiple reviewers, and to serve as a basis for calibration and quality assurance.

Information is being compiled for over 220 restoration projects that represent an investment of more than \$650M. Projects included in the evaluation range widely in size, geographic location, habitat and ecosystem type, restoration features, funding authorities and partnerships. The presentation will illustrate the scope and diversity of the Corps ecosystem restoration program and summarize information on projected versus realized benefits and performance of selected restoration features.

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A Systems Perspective on Addressing Water Resources Challenges in the Sacramento – San Joaquin Bay Delta, an Ecosystem of National Importance

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A moderated panel discussion providing an overview of emerging perspectives on ecosystem restoration within an integrated water resources management framework, encompassing drivers of change in national Administration policies, the regional perspective on the Bay-Delta system, integrated sustainable water management in California, and applications of the systems perspective at the field level with partners and stakeholders.

The Bay-Delta is California's hydraulic heart with very valuable, but fragile ecosystem, conveyance, and flood systems. Despite significant Federal spending and a comparable State share over the past 15 years, the ecosystem has continued to deteriorate. Continuation along the same path is not a viable option. The risks remain real – imperiled water supply for 25 million residents, scant irrigation water for 9 million acres of the nation's most productive farmland, and threatened critical energy and transportation infrastructure that supports the 8th largest economy in the world. In addition, there are fifty-five (55) ESA-listed species in the Delta. These risks transcend the California legal Delta boundaries, and they need to be considered as part of an overall system that encompasses natural and engineered waterways, regional environmental health, public safety, and national, regional and local economic livelihood. One must also consider the political context created as a result of Federal, State and local government responsibilities and the myriad of interested stakeholders.

As the decline of the Bay-Delta ecosystem has accelerated in the last decade, awareness of this crisis has heightened, new alliances have formed and thinking has evolved about how to best solve Bay-Delta challenges. Agencies at all levels with responsibilities for water supply, flood risk management and ecosystem restoration now recognize the need for leveraging resources, combining projects and programs and working on a system wide basis towards true collaborative solutions. USACE and the State of California believe that Bay-Delta solutions must be crafted with the understanding that ecosystem health, water supply, and flood risk management must be inextricably linked to achieve short-term success and long-term sustainability. We are at a unique and critical juncture: the current climate is conducive to effecting change and USACE can contribute significantly. This is not "business as usual."

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Exercising Various Techniques to Engage the Public in Louisiana's Coastal Restoration

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Learning to engage the public in understanding the unique and vital ecological assets of wetlands is a secret very few ecosystem management teams have learned. The Coastal Wetlands Planning, Protection and Restoration Act Public Outreach Committee has been successful in engaging a wide variety of audiences with its multi-tiered approach.

In Louisiana, the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Task Force currently has 151 active restoration projects in development with 86 of those projects having completed the engineering, design, and construction phases. Each of these projects begins and expands through an organized public participation process and is developed with a variety of stakeholders including federal, state, and local governments along with business and industry partners. Over its twenty years history of restoration activities, CWPPRA has used a wide diversity of techniques to engage the public in Louisiana's land loss issues and its urgent need for rebuilding a fragile estuarine ecosystem.

CWPPRA's productive public engagement activities include a mixture of techniques that could be easily replicated by other ecosystem management teams. The active practices prepare the public to engage on a multitude of levels. In addition to its organized public meeting forum, CWPPRA provides the public with access to host of information via its Web site www.LACoast.gov. With approximately a million hits per month, the CWPPRA site includes copies of the defining legislation, detailed standard operating procedures (SOPs), a fact sheet for each project, related wetland maps, educational materials, monitoring data, scientific reports, animations, videos, interactive classroom activities, slide shows, access to information on volunteering, and legislative delegate information.

With less than 1% of the annual budget, the CWPPRA Public Outreach Committee has also created take-away publications that include a glossy biannual magazine titled *WaterMarks*, a variety of educational CDs for teachers of students in grades K-12, posters, and a public speaking venue that includes universities, businesses, and educators. Additionally, CWPPRA publishes a "CWPPRA Newsflash" that includes current Louisiana wetlands topics and upcoming meetings as well as the Louisiana Unified Coastal Community (LUCC or Lucy) calendar.

Providing the public with appropriate access to information and logical, timely ways to become involved are key to promoting ecosystem restoration activities.

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Opportunities for Climate Change Adaptation in Upper Mississippi River Leveed Floodplains

Charles Theiling

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Global and regional climate change models predict 40 percent more annual precipitation in the Upper Midwest, with much delivered in large storm events. Increasing river discharge over the last 70 years has already changed the hydrologic conditions that UMR navigation and flood damage reduction infrastructure was designed for almost 100 years ago. These changes create challenges for farmers in the leveed floodplain, including increased risk of catastrophic flooding and increased costs for pumping interior drainage and floodwater seepage. Challenges for natural resource managers include potential habitat change and reduced ecosystem resiliency because of the decoupling of the river from the floodplain. Other factors influencing large scale floodplain management include: FEMA map modernization, rate changes in the National Flood Insurance Program, and levee decertification which all create further uncertainty for floodplain land management decisions.

An alternative integrated floodplain management plan is necessary to optimize a mix of ecosystem management, flood damage reduction, and crop production in the floodplain. Land set-aside programs like the USDA Conservation Reserve Program and Wetlands Reserve Program have demonstrated great ecological value and their immense popularity with landowners, results in substantial unmet restoration opportunity because of limited funding. It may be very likely that row crop production loss can be balanced by habitat incentive programs, commercial forestry, perennial crops, hunting fees, flood easements, and ecosystem service valuation. There could also be new opportunities to expand flood easements for appropriate levee districts to act as “release valves” that would be allowed to flood first to provide greater levels of flood protection to other levee districts.

Ecosystem management and flood damage reduction can be greatly enhanced in the UMR leveed floodplain and basin. It is important to build, calibrate, and validate integrated models to estimate ecosystem and economic production in the Upper Mississippi River floodplain and watershed. The models can help evaluate alternative floodplain management scenarios and target land use to the most appropriate sites. Climate change adaptation incorporates all Corps business lines (i.e., flood damage reduction, navigation, and ecosystem restoration) and will also incorporate other agency, NGO, and private sector economic interests.

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Restoration of Nutrient-Enriched Everglades through Phosphorus Load Reduction and Fire

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Restoring nutrient-enriched aquatic ecosystems has been a primary focus in the field of restoration ecology. Ecosystem ecologists and managers have long tackled questions concerning ecosystem health including how a system is exposed to, responds to, and recovers from nutrient enrichment, and what additional approaches may be used to accelerate recovery. The present study was a restoration-driven, large-scale ecosystem evaluation of natural recovery in the phosphorus (P)-enriched Water Conservation Area 2A (WCA 2A) and an evaluation of the use of fire to accelerate recovery. The study was conducted at a highly P-enriched cattail-dominated area and a moderately P-enriched mixed cattail and sawgrass area.

After 15 years of reduced P loading to WCA 2A, natural recovery was apparent based on decreased P concentrations in water, plant tissue, and near-surface soil. Recovery trends differed between the two nutrient-enriched areas. Water quality in the highly-enriched area experienced a rapid initial decline in P concentration followed by a slow decrease. This trend was highly correlated with P loading rates. Plant and soil P concentrations decreased slowly but steadily over the same time period. Yet concentrations were still twice as high as that found in the moderately-enriched area. In contrast, surface water P did not decline significantly in the moderately-enriched area, but porewater concentrations declined to levels similar to un-enriched areas by the end of the study. While plant and soil P concentrations also did not demonstrate significant declines, burial of nutrient-enriched soil below lower P-concentration soil was apparent. Overall, reducing P loading was the crucial first step for ecosystem natural recovery. Current recovery trajectories are not reliable for predicting future recovery, and hence additional monitoring is critically needed.

Application of fire to accelerate recovery resulted in the removal of 0.1 to 0.7 g P/m² depending on nutrient-enrichment level and water depth at the time of fire. A temporary surface water P pulse with ash return was observed after each fire. Cattail was stressed by fire resulting in a reduction in primary production and shoot base P concentration, while sawgrass plants were positively impacted by fire. The increase in sawgrass seed germination after fire indicates that surface fire may be an effective tool for the reestablishment of the historical Everglades plant community. However, the seed bank in the highly-enriched area was devoid of sawgrass and contained numerous undesired species. These results indicate that fire may be an effective management tool in the moderately-enriched area for restoring the impacted Everglades, while in highly-enriched area, the use of fire may require additional measures to prevent colonization of undesirable species.

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Long Island Sound: Relative Sea level Rise over the last Millennium

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Coastal salt marsh ecosystems are affected by increasing rates of sea level rise as a result of anthropogenic global warming. We use microfossils in salt marsh peat cores to reconstruct changes in the rate of relative sea level rise (RSLR) over the last millennium and investigate the resilience of marsh environments. The potential of salt marsh deposits for determining rates of relative RSLR stems from the characteristic vertical zonation of flora and fauna in the intertidal zone. Foraminifera, shelled eukaryotic unicellular organisms, are abundant in salt marshes, with their species distribution in intertidal settings primarily controlled by the fraction of time that the salt marsh surface is not covered by sea water. This fractional exposure time is controlled by the elevation of the marsh surface and the local tidal range. Foraminiferal assemblages thus are indicative of a specific level of the marsh surface above mean sea level, and their fossils can be used to reconstruct the position of each sample in a core with regard to mean sea level at the time that the foraminifera were living. We date samples using Hg-pollution profiles, ²¹⁰Pb, ¹³⁷Cs, and ¹⁴C, then reconstruct the position of the marsh surface at the time of deposition relative to mean sea level at that time. Subsequently, we recast these data into the position of paleo-sealevel below modern mean sea level and thus determine the rate of RSLR.

Rates of RSLR as determined from such foraminiferal records averaged about 0.9 mm/yr until about 1600 CE, almost doubled to 1.7-1.9 mm/yr between 1600 and 1900 CE, and finally increased to about 3mm/yr for the last century, the latter in agreement with local tide gauge data. Over the last 1000 years, the marsh accretion in high marsh areas (*Spartina patens* vegetation) kept up with these rates of RSLR in marshes along the Housatonic and Connecticut Rivers with significant riverine sediment input. High marsh areas with smaller watersheds and less sediment input alternated between relative drowning and emergence over the last millennium. Many Connecticut coastal marshes show evidence for accelerations in the rate of RSLR over the last few decades. Typical low marsh foraminifera establish themselves in the high marsh, and with this shift in marsh environment, the rate of RSLR may outpace marsh accretion. A marsh with severely limited tidal inflow (tide gate), showed predominance of the common reed *Phragmites* over high marsh *Spartina patens*. When tidal flow was restored in 1979, marsh accretion had not kept up with the rate of RSLR and low-marsh vegetation (*Spartina alterniflora*) became established. Accretion rates in the newly established low marsh were 5.5 mm/yr, outpacing the local rate of RSLR, and the marsh surface now increases in elevation relative to mean sea level.

Our data show that coastal salt marshes are vulnerable to increasing rates of relative sea level rise, and high marsh areas may become displaced by low marsh. Restriction of tidal ventilation in marshes may lead to *Phragmites* (reed) invasions, and the net accretion rate may be less than that found in open high marsh areas with *Spartina*.

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Restoration of *Thalassia testudinum* and *T.hemprichii* in Atlantic and Pacific Oceans: Sustaining Seagrass Meadows for over 25 to 39 Years

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The world's first large scale seagrass restoration was in Biscayne Bay by Thorhaug in 1972-3 for the recently-closed heated-effluent canal at the Turkey Point nuclear power plant. 6000 seedlings were planted at 0.2 m intervals growing rapidly with 80% success rate after 1 year. *Thalassia* plants reached coalescence in the planted areas after 2-3.5 yr (Thorhaug,1975) while unplanted corridors took many more years for our restored *Thalassia* to grow into them. Another power plant on the same bay was not recolonized with *Thalassia* for 20 yr after its closure of its heated effluents. The animal community recolonizing into the Turkey Point *Thalassia* restoration was measured to be not statistically significantly different from non-polluted control *Thalassia* meadows to the south which never experienced thermal pollution by McLaughlin *et al.* in 1982. In the impacted northern portion on the Biscayne Bay, other barren and degraded areas were restored after we carried out two test plot programs: 1.) 20,000 *Thalassia* seedlings and 5000 *Halodule* sprigs along 2 ha on the north side of a cross bay causeway; 2.) 1 million plugs of *Thalassia* spread at 1m intervals over 59.6 ha extracted pre-beach fill from the coastal shoreline of Key Biscayne; 3.) 203,444 *Thalassia* seedlings mixed with 411,297 *Halodule* sprigs both planted at 1 m intervals over 15 ha; 4.) 13 test plots of 13,000 sq ft each for 200,000 *Thalassia* seedlings and 200,000 sprigs, planted at 1 m intervals with *Halodule* in similar numbers for sprigs and plugs, and *Syringodium*. These *Thalassia* and mixed *Thalassia* plantings were in areas of various water depths (0.2 to 2.7 m), turbidity, ongoing or past pollution effects. These restored meadows of *Thalassia* continued to grow and expand throughout these 30 years and measurements will be discussed. The results of all but some of the test plots were above 69% success and survival rate after two years. A few test plots (chosen by local government officials politically, and who insisted on choosing sites they considered relevant to long-term planning solely because these sites had no seagrass—and which were rejected by us as unviable to restoration of seagrass) failed because conditions were either too deep, too high energy or too turbid water. Sites chosen by us succeeded with minimally 1 seagrass. Two sets of tropical seagrass restoration methods were taught and experimented with as models for wider areas: one in Jamaica (*Thalassia testudinum*) for the Greater Caribbean and one model for SE Asia and Indian ocean in the Philippines (*Thalassia hemprichii*). *Thalassia* was planted in 19 locations in Jamaica (2000 seedlings; 3000 sprigs) and 7 in the Philippines chosen by these respective governments as indicators of various national pollution problems, as well as broad types of environment needed to be restored. In 2011 restored *Thalassia* these areas remain 38, 33, 20 and 10 years after creation as sustainable seagrass meadows, not existing before our planting. These techniques plus our methods for *Halodule wrightii* and *Syringodium filiforme* have been widely copied by other investigators throughout the world. *Thalassia* showed that could be well-restored in many of the normal pollution situations which will be discussed. Larger plantings were carried out.

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Interagency Scientific Oversight of Everglades Restoration: RECOVER Ten Years Later

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The Comprehensive Everglades Restoration Plan (CERP) established a structured framework for providing scientific oversight during CERP implementation. The Restoration, Coordination and Verification (RECOVER) program integrates system-wide science into the restoration effort. RECOVER is a multiagency team comprised of representatives from six federal agencies, four state agencies and two Native American Indian tribes, and as such is a key forum for interagency collaboration in CERP. This presentation walks the audience through the overall structure of RECOVER, focusing on the evolution of governance structure over the last decade, and highlights key lessons learned that may be of interest to other ecosystem restoration programs. Thematic categories of interest include: agency partnerships, RECOVER activities/efforts/products, the evolution of RECOVER structure and processes over time, and RECOVER governance and lessons learned from responding to agency and RECOVER changes.

RECOVER has evolved over the past ten years in response to both internal and external factors. RECOVER has withstood changes in funding, staffing shortages and disagreements about scientific interpretation as well as conflicting agency missions. This presentation will discuss how those challenges were overcome and provide advice to other restoration programs facing similar challenges. This presentation will discuss what has worked, what didn't, where we are heading, and areas where our restoration partners across the country should adopt our "lessons learned" on how to facilitate/manage a multiagency scientific oversight team to enhance restoration implementation and monitoring restoration success.

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A Multi-Species Transition Strategy for Everglades Water Conservation Area 3A

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The U.S. Fish and Wildlife Service (Service) initiated development of the Multi-Species Transition Strategy (Strategy) for Water Conservation Area (WCA) 3A in response to declining productivity of Everglade snail kites, and with the initial goal of restoring WCA-3A as a productive area for snail kite nesting and foraging. WCA-3A historically supported a large percentage of the snail kite production in Florida but has become relatively unproductive since approximately 2005, coinciding with large decreases in Florida apple snail densities and extended wetland hydroperiods. In recent years, wet season water levels in WCA-3A have been too high for long durations in the fall and winter associated with rapid recession rates resulting in extremely low water levels during and after the breeding season. These conditions are believed to contribute to reduced snail kite and apple snail reproduction and juvenile survival (recruitment). To address these water management concerns, the Service worked closely with species researchers to determine how the hydrology in WCA-3A could be improved to provide suitable conditions for snail kites, apple snails, and the habitats they use. Because water levels within WCA-3A affect other imperiled species and habitats, including wood storks and tree islands, we expanded our efforts to include these considerations.

The resulting Strategy provides species-specific water level ranges identified by species experts based on the best available science and associated with successful reproduction, foraging, survival, and suitable habitat conditions. The Strategy's "recommended seasonal range" was developed by the Service taking into consideration the needs of multiple species and emphasizing inter-annual variability. Recommendations are divided into three time periods representing: (1) the height of the wet season (Sep 15 to Oct 15), (2) the pre-breeding season (January), and (3) the latter portion of the peak breeding season corresponding with dry season low water levels (May 1-30). Recommended rates of change between high and low water levels (*i.e.*, recession and ascension rates) were also identified.

The intent of the Strategy is to facilitate decision-making amongst multiple interests and to serve as a tool when evaluating potential water management actions within WCA-3A. To fully evaluate potential actions and avoid unintended consequences, conditions should not only be considered within WCA-3A, but region-wide, as well as how potential actions may affect areas outside WCA-3A and non-target species. Each year, seasonal recommended water levels would be determined by an interagency team based on a comprehensive assessment of region-wide ecologic, hydrologic, and meteorological information. Proper implementation and application of the Strategy to achieve desired ecological benefits requires close coordination between water managers and biologists. Through such coordination, priorities for water management can be identified and compromises can be more easily attained when conflicts arise, while still incorporating the inter-annual variability that is so important in the management of the ecosystem to promote recovery of all species.

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Endangered Species Ecosystem: Striking a Balance Using Flood Risk Management

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The US Army Corps of Engineers (USACE), San Luis Rey River Flood Risk Management Project (FRM or Project) encompasses approximately 576 acres of the lower San Luis Rey River within the City of Oceanside, northwestern San Diego County, California. One key component of the Flood Risk Management Project is to maintain flow capacities within the river channel of 71,200 cfs, which is equivalent to a 100-year flow conveyance level. This is being accomplished by mowing stands of vegetation within the center portions of the river channel. Project elements also include invasive weed species eradication, restoration of temporarily disturbed areas, vegetation management, sediment management, and federal Endangered Species Act avoidance and minimization of effects on listed taxa and their critical habitat, as well as California Endangered Species Act (CESA) compensation measures.

The proposed action may affect federally and state-listed special status species including least Bell's vireo (*Vireo bellii pusillus*), and southwestern willow flycatcher (*Empidonax traillii extimus*). To minimize (federal ESA) and mitigate (state ESA) for these effects, habitat restoration, enhancement, and preservation is being performed within the project boundary and at an off-site mitigation site (state CESA). A detailed restoration plan, based on an adaptive management approach, has been prepared describing the locations for which restoration, preservation, and enhancement may occur and the methods to which they will be restored.

Implementation of the restoration plan includes the eradication of major weed infestations by giant reed (*Arundo donax*), salt cedar (*Tamarisk* sp.), and other noxious invasive weeds; and by using active and passive restoration techniques to ensure native vegetation types that support listed species are being restored (federal ESA minimization; state CESA mitigation). A comprehensive monitoring and reporting program has been implemented which tracks the success of the project and measures progress against an established reference site containing the target habitat type. Contingency measures are also in place to ensure the project's success.

The Corps is successfully balancing the unique challenge of managing flood flow conveyance while maintaining populations of listed taxa and the vegetation types they rely through the eradication of highly invasive weeds, habitat restoration and enhancement, and compliance with the various regulatory agency requirements and permit conditions.

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Establishing High Marsh Habitats within the San Dieguito Lagoon Wetland Restoration Project

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The goal of the 150-acre San Dieguito Lagoon Wetland Restoration Project is to restore the structure and function of coastal wetlands near the mouth of the San Dieguito River. This restoration effort is being carried out by Southern California Edison (SCE) and was required by the California Coastal Commission (CCC) to partially mitigate for the estimated impacts on marine fish populations resulting from the operation of cooling water systems for San Onofre Nuclear Generating Station. One of the project's main features is the creation of 34 acres of high coastal salt marsh habitat.

Restoration of high intertidal habitat zones is difficult due to the infrequency of inundation and high soil salinities. This is especially true in the arid southwestern coastal region and with instances in which marsh restoration involves excavation, and the underlying saline subsoils are left as the primary substrate remaining for planting. Based on field studies, the subsoils that were to be exposed following grading activities within the San Dieguito Lagoon were found to have a higher pH, higher bulk density, lower organic matter, and lower clay content than reference marshes within the region. In order to create conditions favorable for marsh habitat establishment at the San Dieguito Lagoon, a series of studies were performed to determine the most beneficial soil treatment for vegetative growth following grading activities. The first experiments studied pickleweed growth in six soil amendments and a control group. As a result of these nursery experiments, a field test plot was then planted using wetland topsoil as the preferred soil amendment.

Full scale restoration began on December 20, 2008 following approximately 2.8 inches of winter rains and continued through March 2, 2009—a duration of 45 work days. Nearly 6 inches of rain fell on the project site over the planting period. In total, 335,918 2-inch container plants were installed within 36 acres of designated high salt marsh habitat. Planting densities ranged from 1.5 to 2.1 feet between individuals. Higher planting densities occurred in areas of higher elevation (above the 4.0-foot NGVD contour), where past field experiments had indicated that container plantings may be more difficult to establish.

Two years following planting, beneficial results can be easily observed throughout most of the planting areas. Qualitative monitoring has indicated that coastal salt marsh plant species including pickleweed, saltgrass, alkali heath, jaumea, and shoregrass are rapidly becoming established and currently account for approximately 60 percent cover. One of the planting areas has had only marginal success. An adaptive management approach is being taken to monitor and correct this area appropriately. The soil composition in this area had higher clay content, higher soil compaction, and greater topographic displacement from the river channel. As a result, this area has been recently lowered in elevation and several finger channels have been created to encourage plant establishment in this region.

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The Oyster Data Tool: Compiling State and Federal Oyster-related Information into a Single Database

Howard Townsend

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The Executive Order on Protection and Restoration of the Chesapeake Bay, signed by the President in May 2009, includes section 801 on “Monitoring and Decision Support for Ecosystem Management,” which requires work including research and scientific assessment to support decision making for the Chesapeake Bay ecosystem and strengthen environmental monitoring of the Bay and its watershed, including strengthening decision support re health of fish and wildlife, changes in water quality and habitat conditions, and adaptive management to adjust environmental management actions. NOAA's Chesapeake Bay Office (NCBO) has begun to develop the Chesapeake Bay Ecosystem Integrated Information Systems (CBEIIS), an integrated physical and fisheries oceanography database system in support of this goal. CBEIIS will enable timely access to integrated, Bay-wide data from observation and monitoring programs and will be able to create models and maps with whole-ecosystem information. These capabilities will ultimately result in improved understanding of how the Chesapeake ecosystem functions and how alternative management actions may meet society’s needs. A first step in developing CBEIIS and based on a recommendation from the Blue Ribbon Oyster Panel, NCBO has developed an oyster data reporting tool using the CBEIIS infrastructure. Currently this tool reports data from a comprehensive Chesapeake Oyster Database, which includes more extensive data on population surveys, harvest, and disease as well as pertinent physical and water quality parameters. In addition to improving accessibility to the oyster data, new data entry interfaces developed for the oyster database will improve the timeliness of data entry and quality control, and help ensure coordination among state, federal and other partners.

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Addressing the Challenge of Climate Change in the Greater Everglades Landscape

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This project is a two-year research initiative funded by the U.S. Fish and Wildlife Service (USFWS) and the U.S. Geological Survey (USGS) and carried out by a group of researchers at the Department of Urban Studies and Planning at Massachusetts Institute of Technology (MIT).

The study investigates a number of possible trajectories of future landscape transformation in Peninsular Florida in light of four main drivers of change: climate change, shifts in planning approaches and regulations, population change, and variations in conservation financial resources. Through a systematic exploration at the landscape-scale, this research aims to identify some of the major challenges to future conservation efforts.

These alternative futures integrate the best available scientific information on climate change with local knowledge and expertise in order to create a suite of management-relevant scenarios for Peninsular Florida. Stakeholder based scenarios were conceived not as blueprints for the future, but rather as learning tools for management of uncertainty. The scenarios are internally-consistent bundles of assumptions with a number of dimensions. Each scenario is projected into the future using a computer simulation technique that creates land use visualizations called "Alternative Futures". Three future time intervals were simulated for each scenario: 2020, 2040 and 2060. Each Alternative Future visualizes land use patterns and landscape transformations such as coastal inundation, urbanization, and infrastructure changes. Future changes in conservation lands are modeled and/or designed based on the input from local experts and managers and using the best available ecological information and data.

This scenario-based research investigation aims to better illustrate the challenges and future conditions decision-makers may need to consider in developing conservation strategies. The scenarios help managers understand the cumulative impacts of possible decisions across a range of scales and allow them to form partnerships they may need to better prepare for future changes.

Once the simulations are complete, an online tool will also be available to aid decision-making by visualizing the scenarios and their potential impacts at the three time intervals. In short, the scenarios are intended to serve as learning and exploratory tools that enable conservation managers to better understand the different trajectories of change and the forces that shape them.

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Innovative Methods of Integrating Conservation Planning Methods, Conceptual Models, USACE Planning Requirements, and NEPA to Develop a Comprehensive Plan: Missouri River Ecosystem Restoration Plan Case Study

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The Missouri River Ecosystem Restoration Plan/EIS (MRERP/EIS) is among the largest basin-wide restoration planning efforts in the US, and represents an unparalleled opportunity and challenge. The aim of the effort is to identify restoration, mitigation and recovery goals for the Missouri River and its tributaries, ecological systems and native species for the coming 50 years. The complexity of the project and its geographic scale present numerous challenges, among which is the need to provide real engagement opportunities for the interested public and stakeholders, including members of 29 basin tribes, 8 states and dozens of federal, state and local agencies. To address this challenge, a team of planners representing multiple backgrounds and approaches has developed the MRERP roadmap, which incorporates tested and innovative techniques to ensure procedural and legal requirements are met through a transparent, objective, and scientifically based planning approach. The roadmap integrates NEPA principles and practices, the USACE 6-Step Planning Process, the Open Standards for the Practice of Conservation, and the lessons and best practices of previous large-scale ecosystem restoration planning efforts.

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Under what Conditions Might Ecologists Provide Evidence that Influences Decision Making?

Andrew J. Tyre and *Sarah Michaels*

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Ecologists have often been frustrated that good science does not get incorporated into decision making about the natural environment. While communication has been widely regarded as contributing to this problem, it is by no means the only factor. For example, it is important to recognize that not all decision arenas are equally amenable to incorporating scientific findings. Recognizing which circumstances are more amenable than others to scientific input will help ecologists identify when their input is more likely to be utilized than ignored or discounted. As a corollary, technical managers within agencies with responsibilities for managing natural resources that are able to recognize these circumstances will be better positioned to ask for meaningful scientific input than they are currently. Consequently, this paper lays out the conditions under which there is a greater likelihood than usually occurs for ecologists to influence environmental decision making. It does so by articulating some of the essential questions ecologists and technical managers need to ask about the decision making arena in which they are engaged or in which they are contemplating participating. These include, but are not limited to: Who will be making the decision? Will the decision maker actively solicit scientific input? Who will bear the transaction costs of importing scientific advice into decision making? What are the tradeoffs involved in making and then implementing the decision? Illustrative examples will be drawn from efforts to restore endangered species habitat on the Missouri River and Platte River.

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Everglades, Louisiana Coastal Area and Great Lakes Ecosystem Restoration - Federal and State Implementation and Political Challenges – Lessons Learned

Cheryl Ulrich

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The purpose of this session is to enable dialogue between the Federal and State representatives of three large-scale ecosystem restoration efforts: Everglades, Louisiana Coastal and Great Lakes. Implementation of these programs have identified a number of lessons learned related to improved cooperation at the State and Federal levels while dealing with implementation and political challenges. The challenges are numerous, including both programmatic and project-specific. Programmatic challenges include implementing a comprehensive restoration effort with multiple interdependent projects while still developing and revising guidance at the highest levels of government. Inherent cultural differences and organizational structures between implementing partners have made communication and collaboration vital in overcoming implementation challenges. Consistent direction to staff is required from the leadership of both agencies and several different venues for issue resolution is fundamental for success.

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Use of Robustness and Flexibility in Adaptive Management for Addressing Uncertainty

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Adaptive Management (AM) can help address scientific/technical uncertainties by incorporating robustness and flexibility into environmental restoration planning and implementation, and by learning through monitoring and assessment. In Everglades Restoration, adaptive management is a structured management approach for addressing uncertainties by testing hypotheses, linking science to decision making, and adjusting implementation, as necessary, to improve the probability of restoration success. One of the Adaptive Management principles for the Comprehensive Everglades Restoration Plan (CERP) is to incorporate flexibility and robustness into project and program planning, design, construction, and operations to address uncertainty. Robustness is the ability of key design parameters, including engineering, operations, and hydrologic responses, to operate effectively in the face of variability and uncertainty of future events (NRC, 2006). Flexibility is the structural and/or operational capacity to adjust if monitoring indicates the need. The UNESCO Working Group/ASCE Task Committee on Sustainability (1999) argued robust systems may not be the optimal solution for the forecasted future condition, but are near cost-effective for a wide range of possible future conditions.

One of the key considerations in the CERP Adaptive Management Integration Guide (RECOVER, 2010) is that project teams should anticipate future uncertainties and changing conditions and consider robust/flexible alternative designs so that they can function effectively under a wide range of potential future conditions. For projects with significant uncertainties that pose a risk to a project meeting its restoration goals and objectives, there is a greater need to incorporate robustness and flexibility into the planned design. For example, if a project is being planned to store and distribute water, alternatives should be designed to operate under an acceptable degree of risk with consideration to uncertainties associated with future drought and flood conditions. This may also require purchase of land/easements to provide for additional water storage during flood conditions. It could also entail development of a weir as a permanent structure if performing well, but also allow for future height adjustments without any major retrofits or removal of the existing base. Flexibility may include adding three 250 cubic-foot per second pumps in different locations (in lieu of a single 750 cubic-foot per second pump) to provide more options for moving water in a given area. Multiple projects also may be designed in phased increments to allow for mid-course corrections or operational adjustments when newer information becomes available. In addition, operational flexibility can be used in real-time operations to make goal directed adjustments. Although operational flexibility can be a tool in adaptive management, operational flexibility and adaptive management are not synonymous. Some challenges to using robust alternatives include: potentially higher up front costs, may not be the “optimal solution,” difficulties in measuring the benefits of robust alternatives, lack of appreciation or willingness to deal with uncertainties, short term versus long term view, bridging interdisciplinary boundaries, and trust issues.

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A Collaborative Approach to Bay Oyster Restoration

Bruce Vogt

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Overfishing, disease and pollution have left the Chesapeake Bay with only about 1 percent of the oysters it once had. Restoring oysters and the habitat they provide for a multitude of other fish and animals is essential to improving the health of the Chesapeake Bay. NOAA along with the Army Corps and State resource managers, scientists, and stakeholders are initiating a new era of partnership and collaboration to restore oysters across the Bay with a focus on implementing joint, large scale projects in tributaries targeted for their likelihood to succeed. NOAA and the Army Corps with state and other partners, through the Chesapeake Bay Executive Order Strategy, have set a goal to restore 20 Bay tributaries by 2025 with healthy oysters and viable habitat. This ambitious goal comes with significant challenges and to achieve it will require strong leadership, coordination of policy and resources, and application of the best available science and technology. This talk will provide an overview of how NOAA and partners are working toward the Executive Order goal and defining restoration success.

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Delaware's Role in Restoring the Chesapeake Bay

*Jennifer A. Volk*¹ and *Chesapeake Bay Interagency Workgroup*

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The TMDL established by the EPA identifies the necessary pollution reductions of nitrogen, phosphorus, and sediment for the six jurisdictions within the Chesapeake Bay Watershed. Along with Maryland, Pennsylvania, Virginia, West Virginia, New York, and the District of Columbia, Delaware's Watershed Implementation Plan, which contains details on how it will achieve desired load allocations, played a central role in shaping the final TMDL. To achieve the TMDL and restore water quality in local waters and the Chesapeake Bay, Delaware is implementing the pollution control strategies in its WIP while beginning development of its Phase II WIP. The Phase II WIP will build upon Delaware's endeavors to remediate water quality by engaging local governments, watershed organizations, conservation districts, citizens, and other key stakeholders to reduce water pollution.

To stay on schedule and meet the load reductions called for by the EPA TMDL, Delaware's Department of Natural Resources and Environmental Control (DNREC) convened the Chesapeake Bay Interagency Workgroup made up of representatives from all DNREC divisions, the Department of Agriculture, Department of Transportation, Office of State Planning Coordination, County Conservation Districts, the U.S. Department of Agriculture, and other stakeholders. From this workgroup, eight subcommittees were formed to address the specific sections of the WIP; they are: Agriculture, Stormwater, Wastewater, Land Use and Comprehensive Plans, Restoration, Public Lands, Funding, and Information Technology. Subcommittees were charged with recommending and reviewing sub-allocating methodologies to the various point and nonpoint sources within subwatersheds, assessing current data tracking and reporting systems, determining maximum implementation goals and methods to fill program and funding gaps, and assisting with writing and providing information for the Watershed Implementation Plan. These subcommittees also communicating proposed actions to the respective stakeholder groups and soliciting their input on WIP elements. A DNREC representative will share information about the key elements of Delaware's WIP including strategies to reduce nitrogen, phosphorus and sediment loads from wastewater treatment plants; community on-site wastewater treatment systems; septic systems; urban stormwater; animal and row crop agriculture; and degraded forests, streams, and wetlands buffers. Additionally, Delaware's plans to offset pollutant loads from future growth will be presented.

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A Systematic Review of Ecosystem Services from Green Space

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We summarize and evaluate the literature with respect to the benefits of turfgrass or “turf” defined as residential lawns, commercial or institutional turf surfaces and public facilities such as parks and playing fields with the goal of quantifying ecosystem services generated by such areas. Healthy, properly maintained turf and green space provides both regulating and supporting services, including: erosion control, water purification, air purification, temperature modification, oxygen generation, and carbon sequestration. In addition, there are cultural services, including recreation, stress reduction, and obesity reduction. We discuss the evidence for quantitative relationships between green space area and changes in ecosystem services, and corresponding valuation of those changes for use in analyses to quantify the benefits of restoration or other management activities.

We develop a systematic review of the literature to identify and evaluate primary studies that can be used as the basis for such quantitative relationships, and explore the range of values across studies, with the goal of providing metrics and functional relationships for estimating the value of management actions.

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Dutch Dialogues

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No place is more in need of a transformative vision and process for water management than New Orleans and the Mississippi Delta. Long bound by a regime of levees, pumps, and pipes, the city has turned its back on its prime asset, water, and exacerbated its subsidence. After decades of levees and drainage for flood protection and navigation, with channels cut through the marsh for commercial purposes, the wetlands in south Louisiana, now buffeted by the great oil calamity of 2010, are receding at an alarming rate.

A shift in paradigms is fortunately underway. Large scale diversions of the river's flow and sediment can revive coastal wetlands downstream. Plans and initiatives to speed and increase these diversions are in progress. The perimeter defense system built by the Corps of Engineers around the city, though more robust than before Katrina, not only provides a lower level of protection than the urban area needs for safety and reinvestment, but also is less flexible than would be desired. It is nonetheless a base line that must be amplified, supplemented and built upon in the years and decades ahead.

The third component of the storm defense and water management system is the urban water system. Here the balances between existing and envisioned, man-made and natural can be explored. Implementing the idea of living with water instead of fighting against it, the urbanized settlement can over time be transformed. Instead of wasting soil and ignoring water, a shift to cherishing earth and the root it provides, and revealing and revering water is needed. Crucial balances in process of reevaluation include land and water; habitation and infrastructure; buildings and open spaces; hard and permeable surfaces; fresh and salt water gradients; levees, perimeter defense structures, and storm surge; and the effect of variable "sea level" and higher limits on operating levels for the urban water system.

Adaptations are fundamental, but conceivable and ultimately achievable. The planning time frame needs to shift from a five year horizon to fifty years. Through a cooperative endeavor known as Dutch Dialogues, led by Waggoner & Ball, the Royal Netherlands Embassy and the American Planning Association, a vision-driven, learning-based approach is nascent. A consensus-based water strategy just commenced is a key step in this transformative process. To succeed, an integrated approach developed from a multi-level perspective is required. Non-interactive models need to be supplemented. Ecological memory, learning from the past, is instructive and should be recalled.

Several principles and ideas have risen in consciousness with lessons learned. We must make space for water. Landscape is not a secondary idea but a prime contributor to the health and sustainability of the settlement. Trees and plant materials are vital to the livability of this sub-tropical area. Specific attention must be paid to the underlying layers of soil and groundwater. Hydrological units or sub-basins, perhaps developed into polders, are the district level structure of the city. Planning for transportation, infrastructure, and water management should be integrated with spatial planning. At the larger public scale, a circulating water system is essential, multi-purpose infrastructure. Private as well as public property must contribute to the water storage solution. Biological as well as human diversity and healthy development should be encouraged. Working with nature in the ecological borderland that is New Orleans is essential to survival.

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Measuring Economic Benefits of Restoration for Spatial Targeting and Ecosystem Service Trades or Offsets

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Ecosystem service trading and offset programs can reduce costs of compliance with environmental caps (e.g., TMDLs), however, to ensure that they result in environmentally neutral (or better) outcomes requires the accurate measurement of changes in ecosystem services produced by both degrading and restoring activities. Although, it is well-recognized that natural restoration can generate a bundle of ecosystem services, teasing apart the changes to different ecosystem services and understanding the values of those changes creates many challenges. Perhaps, most significantly, the quantitative links are often lacking between structural and functional changes in ecosystems and the outcomes important to human well-being, even though conceptual models of the links may be widely accepted. As a result, a system to evaluate the equivalency of ecosystem service gains and losses across locations must overcome high uncertainty and variability in ecological and human value systems.

We will demonstrate a framework for measuring ecosystem service benefit changes using a case study of invasive plant management in national parks. By applying economic theory and empirical evidence, we have created a spatial economic decision support tool (SEDS) to translate desirable changes in ecosystem services into metrics appropriate for either a) cost-effective targeting or b) quantifying the equivalency of ecosystem services credits for trading or offset programs. The framework uses quantitative indicators to compare site and location characteristics that affect benefits, including: the quality of relevant ecological conditions and processes, presence of complementary inputs that define service capacity and popularity, and scarcity as represented by rarity and substitutability. The potential ecosystem service benefits at a site are the aggregation of these indicators, which is generated with multivariate statistical techniques. Each site is scored relative to a regional distribution of scores.

To estimate how a degrading or restoring activity affects ecosystem service benefits, damage/recovery functions were developed for each service from literature reviews and expert judgment. These functions are evaluated to determine benefits for the conditions that are expected before and after a proposed activity. For restoration projects, the post-project value is also deflated to reflect project risk, meaning that high risk projects values are reduced more than low-risk projects to reflect risk aversion on the part of the decision-maker. The estimated change in the ecosystem service benefit index provides a relative indicator of economic harms or benefits associated with any given activity. The index is also applied to estimate monetary values of changes in ecosystem services by activity and location using spatial benefit transfer.

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Water Quality Challenges in the Chesapeake Bay – the Science Dimension

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The Chesapeake Bay Program Science and Technical Advisory Committee (STAC) operates to (1) improve the understanding of the integrated Basin/Bay ecosystem by reducing uncertainty, (2) use science to develop policy and management actions, (3) assess the accuracy and appropriateness of the measures used to evaluate them, and (4) evaluate effectiveness of practices and policies so adjustments can be made. STAC advises the CBP on the uncertainty associated with all portions of the adaptive-management enterprise, identifies emerging challenges to the restoration effort, and also serves to assess whether the CBP is effectively implementing an ecosystem-based, adaptive management approach. Fulfilling this role during the development and implementation of water quality measures, such as the Total Maximum Daily Load (TMDL) established in December 2010, has led to a string of lessons learned and the identification of new opportunities. STAC can now relay substantive case studies covering both long-standing issues in establishment of the TMDL (monitoring and land use/land cover), as well as emerging issues in its development and implementation (efforts to push partners toward the adoption of climate change as a driver for restoration decision-making).

Within the last decade in the CBP, as well as in other environmental management programs, the adaptive approach has been more fully developed, articulated, and institutionalized to varying degrees. Monitoring is a foundational pillar of an adaptive management approach, providing measures of management effort performance and ecosystem response, thus leading to an increased understanding of the system and its effective management mechanisms. A review of the Program's investment in monitoring, and the capacity of those investments to generate critical and accurate information, was executed via a year-long process involving both scientists and senior-level managers; it resulted in a major re-alignment of funds (approximately \$1.5 million) between program elements in 2010. The program continues to ask itself a number of questions, including: 1) Are institutional changes required to integrate monitoring into adaptive management, and 2) How do we monitor a monitoring program?

Looking forward, initial thoughts of the regional community on likely impacts to the restoration effort from climate change are wide-ranging and relatively speculative. Therefore, a project utilizing USGS-PSU GCM downscaling and HSPF-derived flows and loads of nutrients and sediment is underway. The length of each simulation is 10 years, based on the 1991-2000 base-case run that the Bay Program has been using for model evaluation and calibration. The future simulations are the base-case run perturbed by projected mean climate change (annual cycle in precipitation and temperature) as simulated by six global climate models (GCMs) under three greenhouse gas scenarios (B1, A1B, and A2), a total of 18 different futures. Simulations will be conducted for early, middle, and late 21st century, a total of 54 simulations. The project will quantify the range of projected changes in nutrient and sediment loading to the Bay resulting from climate change, which we will do by comparing future simulations to the historical (1991-2000) simulation. The results have significant impacts on the implementation of a region-wide TMDL.

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Role of Ecosystem Services in Habitat Equivalency Analysis

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The Oil Pollution Act (OPA) of 1990 and the associated implementing regulations set the terms of statutory tort liability for oil spills. These laws include provisions for the assessment and restoration of natural resources and associated services (e.g., recreation, storm protection, carbon sequestration, air and water filtration) in the public trust. The cost of assessing and restoring the damage to these natural resources and services, as well as compensating the public for interim lost value pending full restoration is born by the responsible party. The valuation of these natural resource damages is an important and difficult element of oil spill risk assessment and liability.

As provided in OPA implementing regulations, a natural resource damage assessment (NRDA) is conducted by the trustees of public resources (e.g., federal and state natural resource agencies). A NRDA consists of three phases: (1) preassessment phase, (2) injury assessment and restoration planning phase, and (3) restoration implementation phase. During the preassessment phase of NRDA, the trustees must determine if they have jurisdiction (e.g., if OPA applies) and whether an assessment is appropriate or necessary. The second phase involves evaluation and quantification of potential injuries to natural resources and services and determination of the need for and appropriate scale of potential restoration options. The final phase of NRDA is implementation of the selected restoration actions by or paid for by the responsible party.

The challenge of quantifying the damages to natural resources through scientific and economic studies occurs in the second phase of NRDA – damage assessment and restoration planning. Once the trustees have identified injuries that have resulted from an oil spill, they must quantify them compared to a pre-incident baseline condition. This quantification includes the temporal and spatial extent of the damage, the degree or severity of the damage, and the time required for recovery.

Federal trustees often use habitat equivalency analysis (HEA) to establish the scale (and cost) of compensation under established NRDA guidelines. Typically HEA follows a service-to-service approach to evaluating compensatory restoration. Focusing on ecosystem services presents a useful valuation approach when addressing compensatory restoration (and in the selection of restoration alternatives). The resources and processes supplied by a natural ecosystem are evaluated and often a numerical value is assigned to the services. These resources and processes can include direct natural products, processes (e.g., waste water treatment, flood abatement), and cultural/societal resources (e.g., recreation, aesthetics). Applying ecosystem services to the HEA process, mitigation alternatives are selected based on the net value of the services lost, and those gained through the restoration alternatives.

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Decomartmentalization and Sheetflow Enhancement within Water Conservation Area 3: Challenges in Planning for Large-Scale Ecosystem Restoration Projects

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Often referred to as the “heart of Everglades restoration”, the Water Conservation Area (WCA) 3 Decompartmentalization and Sheetflow Enhancement Project (Decomp) aims to restore more natural flow patterns through the removal of levees and canals within the project area. The restoration of these flow patterns is expected to help restore the historic ridge and slough landscape within WCA 3 and in turn, the native flora and fauna. With successful completion of the Decomp project, 70 miles of continuous flow paths will be restored, from the southern border of the Everglades Agricultural Area to Whitewater Bay; more than two thirds of their original length.

The Decomp project will be implemented in 3 phases, each with their own Project Implementation Report (PIR). Decomp is currently in the planning phase of PIR 1. The scope of PIR 1 includes some degree of backfill and levee degradation of the Miami Canal between structures S-8 and S-151. Recent guidance has broadened the scope of Decomp PIR 1 to include a hydration feature along the northern border of WCA 3A with the intent to rehydrate that area. Decomp PIRs 2 and 3 encompass further canal backfill and levee degradation within the project area. A field test (the Decomp Physical Model) has been designed to answer several uncertainties associated with these future PIRs.

The Decomp project faces several challenges in planning and implementation. Due to the complex hydrologic interactions between WCA 3 and its surrounding areas, the uncertainty of future CERP and non-CERP projects forces the planning team to consider both near-future (2015) and far-future (2050) project benefits. These uncertainties contribute to project scope changes and potential project delays. Water quality is an overarching Everglades restoration concern that directly affects the water entering WCA 3. Several stakeholders follow the Decomp project closely, each with their unique desired outcomes for the project area (recreational fishermen and environmentalists, for example).

The Decomp project is a prime example of the unique challenges faced in planning and implementing large-scale restoration projects. This presentation seeks to highlight the project purpose, status, challenges faced, and path forward.

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How to Proceed with Restoration Construction When Agricultural Chemicals Pose an Ecological Bioaccumulation Concern

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The U.S. Army Corps of Engineers (USACE) Civil Works environmental program focuses on two major focus areas: protection & restoration and stewardship. The protection and restoration program reflects the lessons we've learned as a society in recent years about the importance of re-establishing the natural functions of our nation's [rivers](#), [lakes](#), [wetlands](#) and [coasts](#). Restoration projects range in size from very small to very large. An example of the latter is the key role the USACE is playing in implementing the Comprehensive Everglades Restoration Plan (CERP), which is the largest environmental ecosystem restoration project ever undertaken. The plan focuses on recovering critical ecological features of the original Everglades, including restoring natural water flows. Over time implementation of the plan is expected to help restore habitats that house many rare, endangered and threatened species; improve the water quality of several related lakes and estuaries; and ultimately create a healthy, sustainable ecosystem in south Florida. The project also will improve water supplies and provide flood protection for area residents.

As the future of the CERP continues towards construction of ecosystem restoration projects, many projects will become challenged with handling of agricultural chemicals found during the exploration of the soils management plan. Under the residential land use, no agency or individual has a legal requirement to remove any of the soil impacted by agricultural chemicals from the project site. The presence of the agricultural chemicals only becomes a concern when the land use becomes ecological restoration where the project would place water over the soils, thereby creating potential ecological bioaccumulation concern. During preliminary consultation with the U.S. Fish and Wildlife Service under the Endangered Species Act, it was determined that some of the concentrations of agricultural chemicals could represent a concern to endangered species (specifically Everglades Snail Kite) and other protected bird species if the soils were inundated with water for an extended period of time.

To proceed with the construction of the Indian River Lagoon South C-44 Regional Stormwater Treatment Area project, the USACE Jacksonville District and the South Florida Water Management District jointly developed an approach that addresses the use of the above delineated impacted soils in conformance with State of Florida and Federal regulations. In doing so, said approach properly characterizes the soils, quantifies the stated ecological concern through a robust environmental due diligence process and proposes construction actions to mitigate and/or eliminate these concerns in a cost-effective, practical approach, one that allows the achievement of the project's intended ecological benefits in the shortest feasible time.

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Everglades Restoration Climate Change Modeling Needs

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The Comprehensive Everglades Restoration Plan (CERP), like any ecosystem restoration project, must consider the hydro-meteorological effects of climate change on the hydrologic and ecological processes that drive the ecosystem. For the CERP Climate Change Study, the projected changes in sea level, precipitation and temperature and their effects on the surface water and groundwater systems in South Florida will be studied by using appropriate hydrologic, hydraulic, hydro-geologic, and hydrodynamic modeling codes. Based on existing agreements for interagency cooperation and consensus in the modeling approach, a common suite of robust modeling tools will be developed and utilized by the participating agencies (USACE, USGS, SFWMD, DOI) in the study. Primarily, four types of hydrologic and hydraulic (H&H) models, each at different spatial scales, will be utilized: a) regional scale system models, b) integrated surface water groundwater (ISGW) sub-regional models, c) hydrodynamic estuarine models and d) ocean storm surge models. The above models will exchange information where appropriate and output from these hydrologic models can also serve as the drivers for conceptual ecological models or the basis of other ecological evaluations utilizing H&H surrogates.

Due primarily to the low elevation and very flat topography, elevated groundwater levels and highly conductive surficial aquifer within South Florida, it will be essential to pursue the development of density-dependent integrated surface water/groundwater (ISGW) models for the study area. These models will be capable of performing continuous longer term simulations that are particularly suited for evaluating the effect of climate change on salinity intrusion, water supply, well-field vulnerabilities, ecosystem health and vegetation change. In addition to the aforementioned models, it is necessary to have an integrated tool capable of performing event-scale modeling to determine system response and flood performance under short-term phenomenon such as intense rainfall flood events and accompanying rapid operational changes.

In order to meet the above requirements, the CERP Climate Change Study team has proposed a dual modeling strategy that includes supporting the U.S. Geological Survey's (USGS) development of density-dependent ISGW models and supporting the USACE Hydrologic Engineering Center (HEC) in their efforts to couple HEC-RAS, HEC-HMS, and USGS-MODFLOW.

All models will be constructed in reference to the National American Vertical Datum, 1988 (NAVD88) as mandated by USACE and CERP guidance. Only agency certified software will be employed and modeling products will undergo agency and external peer review.

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Maryland's Role in Chesapeake Bay Oyster Restoration

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With the recent adoption of the Maryland's new oyster plan, the state has increased the area of its oyster sanctuaries to include 24% of the oyster habitat within its portion of Chesapeake Bay, and is increasing the role of oyster aquaculture while maintaining a scientifically managed wild fishery. Maryland collaborates with Virginia as well as federal agencies (NOAA, U.S. Army Corps of Engineers, and U.S. Fish and Wildlife Service) and non-profit organizations (Oyster Recovery Partnership) to achieve the goals of the plan.

Working with our partners, Maryland intends to rehabilitate degraded habitat within sanctuaries. An area is selected for restoration based on water quality, larval retention, the prevalence and intensity of disease, and the chances of natural spat set. When an area is chosen, historic oyster bar maps are consulted to determine the previous extent of the oyster bars. Side-scan or multibeam sonar is then used to determine current bottom conditions and locate habitat suitable for restoration activities such as the aggregation of buried shell, and the addition of new shell and/or alternative substrates. The rehabilitated areas are then available for a natural spat set or seeding with spat on shell produced by state hatcheries. NOAA provides financial support to the hatcheries as well as logistical support such as multibeam sonar scanning. The Army Corps of Engineers assists with site selection and constructs artificial reefs from alternative substrates.

Through the NOAA-sponsored oyster metrics team, Maryland and its partners are also collaborating to set restoration goals for oyster sanctuaries, including the amount of habitat that should be restored and the density of oysters necessary to provide a self-sustaining population, support a typical reef community, and provide a particular level of ecosystem services. Although goals may differ depending on what is feasible in a particular area, we hope to develop a uniform approach to restoration goals and measurement of progress toward these goals.

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Restoration Planning for the Hudson-Raritan Estuary – An Example of Collaboration

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The Hudson-Raritan Estuary (HRE) is one of the most urbanized estuaries in the world, and centuries of urban and industrial land uses have resulted in severely degraded ecological conditions. The Estuary spans the boundaries of many municipalities within New York and New Jersey (including New York City). Planning for restoration within such an ecologically and politically diverse system poses many challenges. In 1988, the HRE was designated an “Estuary of National Significance” and included in EPA’s National Estuary Program (NEP). In 1996, the NY/NJ Harbor Estuary Program (HEP) completed a Comprehensive Conservation and Management Plan (CCMP). Included among the CCMP’s recommendations was the development of a comprehensive strategy for habitat protection and restoration.

To advance this strategy, the New York District Corps of Engineers (NY District) with its partner the Port Authority of New York and New Jersey (PANYNJ) spearheaded the effort to build consensus among the region’s stakeholders on the ecological restoration goals and targets. Using this information they developed a Comprehensive Restoration Plan (CRP) for the HRE, which was made available for public comment in March 2009. The CRP represents the combined visions of 60+ stakeholder organizations and resource agencies and is a long-term, evolving approach intended to guide environmental improvements within the HRE. The Plan also coordinates the roles and responsibilities of interstate governmental bodies and non-government organizations conducting ecological restoration within the HRE.

Early in the planning process the NY District and the PANYNJ engaged the region’s major stakeholders in the development of the plan. The restoration goal and targets were developed through a series of workshops that were organized and attended by resource agencies, non-governmental organizations, restoration practitioners and academia. These stakeholders agreed upon the CRP’s goal, to create a mosaic of diverse habitats, and defined the Target Ecosystem Characteristics (TECs) for the region. The TECs were developed to address the restoration needs and opportunities expressed by stakeholders within the context of a physically altered and urbanized landscape. HEP Restoration Workgroup meetings are regularly held to ensure that the CRP remains a living document and continues to represent the unified plan for all of the region’s stakeholders.

This effort has successfully built momentum and dedication to collaboratively restore “The Waters We Share.” Several of New York City’s initiatives reinforce the need for ecosystem restoration – the 2010 Comprehensive Waterfront Plan stresses the need for ecosystem restoration and the provision of public access to the waterfront. PlaNYC is promoting green infrastructure as a cost-effective way to decrease reliance on large capital infrastructure projects. These planning efforts have resulted in broad support for new stakeholder restoration initiatives. For example, this past year saw the start of first experimental oyster reefs in the HRE. The City of Yonkers is planning a habitat restoration/daylighting project for the Saw Mill River. Local groups are cleaning up waterfronts, halting nonpoint sources of pollution, and restoring fish passage. This presentation will discuss the collaborative process of developing the CRP and the successes that have been achieved to date."

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The Great Lakes & Mississippi River Interbasin Study (GLMRIS)

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New species have been introduced into the Mississippi River and Great Lakes basins during the last half of the 1900's and continue through present as a by-product of international trade. At the same time, environmental laws have changed the way municipalities and industries dispose of their waste products into rivers and streams, resulting in improved water quality in many lotic environments, which has allowed aquatic organisms to disperse over a greater area. This greater dispersal was seen as positive when it restored native species to their historic range; however, it has been environmentally, economically, and socially problematic when it allowed non-native species to colonize new areas. These aquatic nuisance species (ANS) can be defined as any nonindigenous species that may threaten the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters.

Potential impacts of the spread of ANS range dramatically within the Great Lakes and Mississippi River basins. For example, the commercial and sport fisheries of the Great Lakes, which may potentially be impacted by invasive species from the Mississippi River basin, have been reported to be worth some multi-billion dollars annually. Similarly, the forecasted management costs that may be incurred by the spread the Zebra mussel, which moved from the Great Lakes into the Mississippi River basin, are estimated to cost between \$100M and \$400M per year.

The U.S. Army Corps of Engineers (USACE), in consultation with federal agencies, Native American tribes, state agencies, local governments and non-governmental organizations, is conducting the Great Lakes and Mississippi River Interbasin Study, (GLMRIS). In accordance with the study authorization, the USACE will evaluate a range of options and technologies (collectively known as "ANS controls") to prevent the transfer of aquatic nuisance species between the Great Lakes and Mississippi River by aquatic pathways. As part of this study, USACE will conduct a detailed analysis of various ANS controls, including hydrologic separation. The presentation will detail the two Focus Areas of the study, outline the purpose and intent of GLMRIS, as well as document current progress and path forward.

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The Nexus Criterion: Linking Resource Injuries to Restoration Projects

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In a natural resource damage assessment under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or the Oil Pollution Act (OPA), trustees often evaluate and choose among competing restoration proposals using criteria identified in both sets of regulations. A key criterion that the restoration project must satisfy is a demonstrable linkage, or reasonable nexus, between the proposed restoration actions and the injured natural resources. When the proposed restoration is for the same type of natural resource or habitat as the resources giving rise to the damages claim, in the same location as where the injuries occurred, i.e., in-kind and in-place, this relationship is readily apparent. However, restoration projects of a different type or location are possible when there is a nexus relating the resource injuries to restoration actions intended to restore those injuries. We will present examples from California where the injury/restoration nexus supported a breadth of restoration projects from New Zealand to Alaska arising from a single incident.

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Increasing Longitudinal Aquatic Habitat Connectivity on the Upper Mississippi River System

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The Upper Mississippi River System (UMRS) has a series of 29 navigation dams on the Mississippi River and 7 navigation dams on the Illinois River that restrict fish movements. Of the 143 native fish species in the river system at least 40 species are migratory.

The design characteristics and operation of most UMRS navigation dams allow both upriver and downriver fish passage. Downriver fish passage can occur through the locks and the gated sections of the dams. Some fish may pass upriver through the navigation locks, but the locks do not provide favorable pathways for upriver fish passage. Opportunity for upriver fish passage is dependent upon hydraulic conditions at the dams, fish behavior and swimming performance.

Operational changes and structural modifications at UMRS navigation dams are possible and may improve opportunity for upriver fish passage throughout the UMRS. Improved access to habitats should benefit native fish and mussel populations in the river system.

Innovative numerical hydraulic modeling and fish behavioral analyses are providing design criteria for fish passage improvements on the UMRS.

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Reducing a Nuisance in the Comprehensive Everglades Restoration Plan

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The Comprehensive Everglades Restoration Plan (CERP) is known for the concept that getting the “quality, quantity, timing, and distribution” of water right in the Everglades system will achieve Everglades restoration. However, Florida has an extensive history of importing and culturing non-native flora and fauna. Unfortunately, non-native species establish quite well in disturbed and undisturbed areas. In many instances, non-native species out-compete native species, resulting in loss of native species and quality ecosystems. Many areas of Florida, including the Everglades and project areas proposed for the CERP, have non-native species that create problems in the ecosystem and water management structures. Simply getting the “quality, quantity, timing, and distribution” of water right does not necessarily achieve ecosystem restoration. Invasive species need to also be considered.

The Corps spends in excess of \$100 million dollars of Operations & Maintenance (O&M) funds each year managing invasive species. The State of Florida also spends millions of dollars each year managing invasive species. O&M of CERP projects is cost-shared 50/50 with the local sponsor. It is becoming clearer to managers that invasive species can be very costly to manage. Managers are realizing that invasive species should be addressed sooner, in earlier phases of a project, in order to maximize ecosystem restoration benefits achieved and to minimize O&M costs associated with managing invasive species.

During discussions regarding the CERP Master Agreement, the Corps and the sponsor agreed that invasive species issues and costs need to be addressed and evaluated in the planning of the CERP, and that additional policy and guidance should be provided. As such, a memorandum was issued in May 2010 from the Corps’ South Atlantic District. This presentation will discuss how this policy is being integrated into the planning, design, construction, and O&M of the CERP program, and the hurdles encountered. Specific project examples will be presented.

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Planning Hurricane Storm Damage Risk Reduction with an Emphasis on Minimizing Impacts to the Lake Pontchartrain Basin

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The United States Army Corps of Engineers, Mississippi Valley Division, New Orleans District is constructing a Hurricane and Storm Damage Risk Reduction System (HSDRRS) project that minimizes impacts to the Lake Pontchartrain Basin and included extensive ecosystem modeling during the design phase. The authority for this project was provided as part of a number of Hurricane and Storm Damage Risk Reduction System (HSDRRS) projects spanning southeastern Louisiana, authorized and funded by Congress following Hurricanes Katrina and Rita.

The project features include a surge barrier and gated structures within the Lake Pontchartrain Basin. The first feature, referred to as the Borgne Barrier is the largest design-build civil works project in Corps history, includes three gated structures and a 1.8 mile barrier wall that stands 26 ft above the water line to reduce storm surge from coming from Lake Borgne and the Gulf of Mexico into the New Orleans Metropolitan area. The second feature, referred to as the Seabrook Complex is comprised of one navigable sector gate and two non-navigable vertical lift gates that will be operated to reduce Lake Pontchartrain storm surge, and maintain existing flow velocity conditions to allow safe navigation and migration of fish and crustaceans. Design techniques for both features which minimize fishery and estuarine impacts include: sloping the gate structures, number of gates and alignment to allow safe navigation, fish passage, improved water quality, and avoided Gulf Sturgeon critical habitat. Construction techniques included the beneficial use of dredged material to nourish 205 acres of the subsiding Golden Triangle marsh, and maintaining flow through Bayou Bienvenue and the Gulf Intracoastal Waterway during construction.

As part of the environmental impact analysis of this project and to inform project design, extensive system modeling was completed. Hydrodynamic models such as TABS-MDS, Adaptive Hydraulics (ADH), and a Particle Tracking Model (PTM) were utilized to assess salinity, velocity, and fishery transport. Dissolved oxygen was modeled using a steady-state mass balance for a continuously stirred tank reaction. USGS is currently monitoring to validate the modeled impacts and assess the seasonal variability of the water quality in the Gulf Intracoastal Waterway, the Mississippi River Gulf Outlet and the Inner Harbor Navigation Canal and the affects of the HSDRRS new structures.

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Potential Impacts of Climate Change and Sea Level Rise on South Florida's Coastal Wetlands

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Mangroves form the defining ecological structure of South Florida's coastal wetlands and provide important ecosystem services including shoreline stabilization, protection from storm surge, habitat, nurseries, and trapping sediment. Projected 21st century changes would have significant impacts on this coastal environment and the ecosystem services it provides. The IPCC 2007 summary report identifies mangroves and salt marshes as ecosystems that "are likely to be especially affected by climate change." As part of the Marine and Estuarine Goal Setting for South Florida (MARES) Project, a conceptual ecological model (CEM) for the coastal wetlands of South Florida is being developed to provide science-based guidance to managers and policy makers in their efforts to sustain the ecosystem and its diverse ecological services in the face of projected global changes in the 21st century. MARES is funded by NOAA's Center for Sponsored Coastal Ocean Research and is a collaborative multi-institutional interdisciplinary effort aimed at reaching a scientific consensus on "the defining characteristics and fundamental regulating process of the South Florida coastal ecosystem."

Changes that exert pressures on the South Florida coastal wetlands identified in the CEM include sea level rise, storm frequency and intensity, rainfall and evaporation, air and ocean temperatures, and freshwater flow. The components are interconnected and affect multiple biological, physical, and chemical attributes of the ecosystem. For example, increasing air and sea-surface temperatures will potentially lead to increasing frequency and intensity of tropical storms. Hurricanes Andrew (1991) and Wilma (2005) and their associated storm surges caused substantial die-off in the mangrove forests of the southwest coast (Smith et al. 1994; 2009; Wanless et al. 1994) with a number of related effects including increased erosion due to uprooting of trees, increases in carbon and nutrients released into the waters, and repopulation of denuded areas by invasives. Erosion of denuded areas prevents mangrove propagules from taking hold on the deepened surfaces (Wanless et al. 1994), so these areas convert to intertidal mud flats that remain barren for years (Smith et al. 2009), and ultimately to shallow estuarine environments as sea level rises.

Efforts are underway to determine the effects of past-sea level rise on the South Florida coast and to forecast likely impacts of future sea level rise. The marshes and mangrove forests of the southwest coastal area of Florida developed and stabilized during the last approximately 3,500 to 2,400 calendar years – a period of relatively slow rates of sea level rise averaging approximately 4 cm per century in the region (Wanless et al. 2000). Pollen assemblages from cores along the coastal zone clearly document the transition from freshwater marshes to mangroves, and the associated molluscan assemblages indicate increases in salinity. By tracking the position of transitional fauna and flora in the cores, we can estimate former positions of sea level and rates of adaptation or migration of the component species. This information will provide land-management agencies with information on the effects of sea level rise on the ecosystem and potential resource management strategies for the next century.

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Ecology, Economics, and Psychology (Psychoecoeconomics): Motivating Farmers Toward Cost-effective Actions Through Performance-based Incentives

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The current approaches to reduce nonpoint source (NPS) pollution from U.S. agricultural land, including voluntary cost-sharing of predefined BMPs, land set-aside programs, and regulation of concentrated animal feeding operations (CAFOs), are not affecting the changes necessary to result in improved water quality in most regions of the country. Alternative approaches are needed to stimulate producers to seek out and implement the most appropriate and cost-effective actions for their operations. The use of performance-based incentives within a local, farmer-driven initiative can provide the enthusiasm and focus on outcomes that are needed to improve water quality, enhance farm income, and sustain efforts into the future.

The lack of clear environmental goals and rigidity of implementation in our current conservation programs creates a disconnect for producers. By bringing producers together to understand the linkages between farming and water quality in their watersheds and facilitating their ownership of the issue creates motivation, enthusiasm, and the sharing of innovative ideas for NPS pollution control. Performance-based incentives are payments that result from achieving a specified environmental outcome, and not attached to any specific practice. This approach gives farmers the flexibility and incentive to achieve performance targets in the most cost-effective and appropriate way for their farm business.

This paper examines the lessons learned from working with producers in Iowa, Vermont, and Maryland on the use of performance-based incentives. Using these lessons learned to inform policy makers and conservation program managers will be important to future success of agricultural NPS pollution control.

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Balancing the Development and Maintenance of Waterways with Ecosystem Protection and Restoration

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The majority of urban ports, harbors, and waterways are set in areas of natural deposition, thus requiring periodic removal of sediments (dredging) to maintain functionality and safe navigation. For older urban areas undergoing waterfront redevelopment, the adjacent waterways may have not been maintained for decades, and the thick layers of accumulated sediment often contain elevated levels of contaminants. Concerns about the potential release of contaminants and impacts to benthic and aquatic ecosystems can result in the sediment being designated as unacceptable for traditional open water disposal. Other disposal alternatives (such as treatment and/or upland placement) are typically far more costly and present other potential risks associated with the increased handling and transportation elements.

Confined aquatic disposal (CAD) cells are increasingly becoming the selected alternative for the management of these unacceptably contaminated sediments. CAD cell construction involves the excavation of native materials to create a depression on the seafloor within a harbor or coastal area, typically near the site where the contaminated sediments will be dredged. The depth and configuration of the constructed CAD cell depend on the geotechnical properties of the native material, the characteristics of the overlying water column, and the expected capacity requirements of the project. Depending on its properties, the native material removed during cell construction has the potential for beneficial use such as marsh augmentation, mudflat creation, or general upland fill. Once filling of the CAD cell is completed, it can be capped with a layer of clean material, or, depending on the setting, it can be allowed to settle and self-cap with natural deposition.

CAD cells have now been constructed in six New England harbors with usage dating back to 1981. CAD cells were selected as the preferred disposal alternative because the approach provided an acceptable compromise when cost, logistics, regulatory acceptance, environmental risk, and perception of various alternatives were all considered. The usage of CADs has been monitored as part of the Disposal Area Monitoring System (DAMOS) Program, initiated in 1977 by the New England District of the Army Corps of Engineers. The DAMOS Program provides comprehensive monitoring and management to address environmental concerns associated with the use of all types of aquatic disposal throughout the New England region.

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Balancing Competing Priorities in an Urban Creek Restoration in Toronto Ontario Canada

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A restoration initiative can be carried out in distinct approaches depending on perspective. Given that ecosystem restoration work requires permit approvals, the perspective is dependent on the views of the review agent. For the restoration of Highland Creek in the City of Toronto Canada, these differing views were based on priorities related to:

- Infrastructure protection and erosion control
- Sediment transport for fisheries resources
- Valley health, vegetative and terrestrial connectivity.

The erosion concerns are significant, protection of the infrastructure is seen as crucial in avoiding catastrophic impacts to the water quality if the event of infrastructure failure, i.e. slope stability and bed failure exposing sanitary sewer pipes.

Sediment transport providing dynamic conditions by which fish species can pass, reside and propagate is a key element into re-balancing the ecosystem in the reach. Fish habitat is an important overriding objective in creek systems.

Valley health in protecting vegetative resources is important in stabilizing embankments and providing refuge and connectivity for species in an urban areas where forests are being depleted.

Balancing these objectives is difficult, however possible if compromise and convergence between stakeholders can be achieved. This project examines the approach taken to satisfy objectives using engineering, natural channel design principles, and geomorphic relationships. Methodologies for the design of instream structures, earth retaining systems and the application of “Adaptive Management” will be examined as they relate to achieving a restoration solution.

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The NRCS/USACE Partnership Handbook: A Field Guide to Working Together Toward Shared Goals

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As part of the continued collaborative effort between the Natural Resources Conservation Service (NRCS) and the U.S. Army Corps of Engineers (USACE), a handbook for field staff has been developed. *The NRCS/USACE Partnership Handbook: A Field Guide to Working Together Toward Shared Goals* is a tool to be used at the field level to stimulate and facilitate active cooperation and collaboration between the two agencies. The handbook contains basic information about each agency's missions, programs, capabilities, and modes of operation. Identifying and understanding each others' mutual interests can lead to developing shared goals and leveraging resources to implement joint solutions. Case studies and examples are included to illustrate what has worked in the past and where further collaboration and problem solving is needed to reach better results in the future.

Often, the differences in agencies' business practices can act as barriers to collaborative efforts. Without coping mechanisms available, frustration soon replaces the initial enthusiasm. A last chapter of this handbook focuses on identifying common and recurring problems in the collaborative effort and suggests ways to minimize and even eliminate those barriers, including elevating problems to the NRCS/USACE liaisons to assist in finding mutually acceptable solutions. This paper will provide highlights of the NRCS/USACE Partnership Handbook including a special emphasis in the identification and potential solutions to those barriers to collaboration.

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Using Historic Analogy to Evaluate How Future Climate Changes May Affect Chesapeake Bay and its Restoration Trajectory

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After more than two decades of monitoring and effort, it is abundantly clear that restoring the Chesapeake Bay is a daunting challenge. It is also very clear that unusual weather events and interannual climate variability can have profound effects upon the Chesapeake Bay ecosystem and efforts to restore it. These facts emphasize that effective restoration strategies must consider how projected climate changes may affect the physical, chemical, and biological processes that shape the Chesapeake and influence the trajectory of restoration progress. While the strong climate variability that the Chesapeake experiences poses challenges, it can also be leveraged to provide insights into how climate changes affect the Bay's key estuarine processes and populations. This presentation will utilize water quality, plankton, and fish population information that has been collected by the Chesapeake Bay Program and its partners for more than two decades to provide insights into how a drift in climatic conditions may shape the Chesapeake and influence the trajectory of the restoration process.

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Application of Three-Dimensional (3D) Computational Fluid Dynamics (CFD) Modeling in Assessing Flows at Culvert S65AX in South Florida

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S65AX structure is a double-barrel corrugated metal pipe culvert with discharge regulated by manually controlled slide gates. The culvert is located on Canal C-38 approximately 10.5 miles downstream from Lake Kissimmee. S65AX has a nominal design flow capacity of approximately 500 cfs. Culvert S65AX acts as a bypass for S65A spillway when there is excessive rainfall in the Kissimmee River catchment. A recent attempt to verify flow estimates for structures in Pool 65 revealed that S65AX culvert had no streamgauging data to allow an accurate assessment of flow through the culvert. Since there were no plans to carry out flow measurements at the culvert before hurricane season ends, it was imperative to find alternative ways of verifying current discharge numbers in DBHYDRO. Numerical modeling using computational fluid dynamics (CFD) approach was identified as an effective tool for assessing and validating flows at S65AX. This paper describes rating improvements carried out for S65AX using simulated flow data obtained by CFD analyses.

The norm for improving flow rating of hydraulic structures in the South Florida Water Management District (District) has been to calibrate rating equations to field flow measurements. This approach works and it has been the standard adopted by many water administration agencies. However, due to the cost of streamgauging and the ever-increasing number of hydraulic structures, some structures end up having few or no flow measurements to permit flow rating analysis to be performed. Nonetheless, the lack of streamgauge data does not absolve the District from providing reliable flow estimates at culverts to the general public.

To generate data for S65AX, a parallel pressure-based non-hydrostatic solver in commercial software FLUENT was used to conduct the simulations. A 3D mesh of two circular barrels with sluice gates was used to simulate flow at S65AX. To improve the current flow rating, NFLOW coefficient for full-pipe flow equation was optimized using a form of Newton-Raphson numerical method embedded in MS Excel (Solver). Discharge coefficient $C = 0.73$ was found to be optimal for predicting full-pipe flow at S65AX when all 11 CFD data were used. The impact assessment showed a mean annual difference of 20% between the new and existing rating. Since the difference exceeded the 5% threshold required to change historical flow data, it was recommended that S65AX flow data in DBHYDRO be recomputed with the new coefficient and reloaded accordingly.

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Estimation of Aboveground Biomass Productivity and Nitrogen Accumulation at Four Years After Establishing Woody Buffer at a Riparian Area in the Han River, Korea

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Cultivation of agricultural crops with fertilization has caused many non-point source (NPS) pollution problems. Riparian forest buffer contributes to control NPS pollutants such as nutrients and sediments from agricultural lands. *Populus* species well adapted to the moist conditions are commonly used as a riparian woody buffer because of rapid growth, high water and nutrient uptake ability. Five *Populus* clones (*Populus euramericana* 'Eco28', *Populus deltoids* x *P. nigra* 'Dorskamp', *Populus deltoids* x *P. deltoids* '97-19', *Populus koreana* x *P. nigra* var. *italica*, 'Suwon' and *Populus alba* x *P. glandulosa* '72-31') and other five forest species (*Salix alba* '131-27', *Liriodendron tulipifera*, *Metasequoia glyptostroboides*, *Quercus palustris* and *Acer okamotoanum*) were planted to install riparian woody buffer in the space of 2,500 trees ha⁻¹ at a riparian area (N 37° 29' 57", E 127° 27' 45") in the Han river, Korea in 2007. Survival rate, above-ground biomass, visible injuries by disease and/or insects and defoliation by weakness of vitality were investigated for all the species after 4th growing season. Also the storage potential of nitrogen, which is the major contributor of NPS, was estimated for the five *Populus* clones in above-ground biomass. Average survival rate of five *Populus* clones and one willow clone was 83.8%, which was better than that of the other species, 52.6%. Clone 'Dorskamp' showed the best survival rate of 91.7%. *Populus* clones and *Salix* clone evaluated to have higher visible injuries compared to the other species. Actual above-ground biomass of all the species decreased to 22.7% due to the reduction of survival rate. Clone '97-19' produced the highest above-ground biomass, which was estimated as 36.5 Mg ha⁻¹. However, *Metasequoia glyptostroboides* was the lowest in above-ground productivity. Nitrogen storage potential in above-ground biomass of *Populus* clones was high in order of actual above-ground biomass. Clone '97-19' showed the highest nitrogen storage potential in above-ground biomass, which was estimated as 223.4 kg ha⁻¹. Clones '97-19' showed the best adaptability, which was evaluated with survival rate, above-ground biomass and visible injuries in the riparian area, and followed by clones 'Dorskamp' and 'Eco28'. As a result, the three clones seemed to be the best candidate *Populus* clones for the establishment of riparian woody buffer.

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Case Study: Riparian Habitat Restoration for Improved Water Quality and Habitat in Highly Developed Suburban Watershed, West Whiteland Township Park, Exton, PA

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The Exton Park restoration in West Whiteland Township, PA represents a unique project involving ecosystem restoration, public-private partnerships, volunteers from local community, as well as providing benefits that reach beyond the borders of a straight-forward riparian restoration project. The 713-acre tract referred to as Exton Park was purchased cooperatively by Chester County and West Whiteland Township from an adjacent private school for open space preservation and recreational needs of a rapidly growing community. Habitat preservation and enhancement have been identified as major objectives related to natural resource management within the park. The park is in the Brandywine-Christiana Watershed. Weston Solutions, Inc. (Weston) has made a five-year commitment to partner with West Whiteland Township to provide funding, scientific expertise and volunteers for the park habitat restoration and other park goals. This case study discusses two years of day-long restoration events at the park. Weston and the Township worked closely together to balance best science with objectives of multiple stakeholders, including Township's Master Plan, costs/budget, neighboring property concerns, and users of the park, including wildlife enthusiasts.

Restoration activities were conducted in September 2009 and 2010 and included stream riparian buffer plantings (tributary to West Valley Creek), removal of invasive species in the riparian and pond area, improving access to natural areas, and planting native species at a historic building located on the property. The scientific benefits of the project provide for increased biodiversity, enhanced wildlife habitat, reduced flooding, enhancing water quality (helping local watershed's "Red Streams Blue" program), enhancing transpiration and groundwater recharge. Social benefits include increased biodiversity for bird/wildlife watching, increased recreational space, beautifying the park and historic building landscaping, enhanced accessibility, and public education. The park is immediately north of a county trail, which links other parts of the county, and provides recreational value beyond the park borders. The plantings in 2010 consisted of 630 trees (7 species) and shrubs (19 species) (430 in 2009), 70 willow (*Salix nigra*) stakes harvested from the site, and 200 flower bulbs. Plant species were selected to provide high diversity and wildlife value (foraging and nesting habitat) and for historical accuracy (flower beds around the 19th century building). Eastern US/Pennsylvania area native plants were exclusively used because they are expected to thrive in the local setting and attract native wildlife. Due to the number/variety of bird species and other wildlife sighted, the park has been designated a "sensitive wildlife area." Each event involved over 100 volunteers from the Township, Weston employees/family members, School at Church Farm employees, students and alumni, local birding enthusiasts, and other local businesses.

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Development of SWAT Models to Quantify Sediment and Nutrient Losses from Missouri River and Upper Mississippi River Basins

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Excessive outputs of sediments and nutrients arising from agricultural and industrial activities in the Mississippi River Basin are degrading the water quality and caused the level of dissolved oxygen in a large zone of the Gulf of Mexico along the Louisiana-Texas coast below the threshold for survival of most aquatic organisms. The Missouri River Basin (MORB) is by far the major supplier of sediment to the Gulf. The Upper Mississippi River Basin (UMRB) is the most productive agricultural region in the U.S. and discharges more nutrients into the Gulf than any of the Mississippi River's seven major tributary basins. Two nutrients of concern in the Missouri and Upper Mississippi River basins are phosphorus and nitrogen. This study focuses on the development and application of the Soil and Water Assessment Tool (SWAT) model to quantify sediment and nutrient loads in streams and the loads delivered to the Gulf of Mexico from watersheds in the MORB and UMRB. With incorporating the latest data and features in the watershed, the SWAT model will give more robust estimates of flow discharge, sediment, nitrogen, and phosphorous loadings from each of the 8-digit HUC subbasins and the larger 4-digit subbasins, along with the total outflow from the MORB and UMRB. The principal source areas for sediment and nutrient discharged to the Gulf will be identified across varying scales of time and space. Additionally, the SWAT models developed in this study can be used to gain a further understanding of the MORB and UMRB and their relation to water quality and ecological health in the Gulf, and to assess best management strategies for reducing nutrient loading into the Gulf of Mexico.

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